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STRAITS SETTLEMENTS

Vol. IX 4th May, 1937 Part 2

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1937

THE

GARDENS' BULLETIN

Vol. IX 4th May, 1937 Part 2

NOTES ON MALAYAN FERNS, WITH DESCRIPTIONS OF FIVE NEW SPECIES.

By R. E. Holttum.

At various times during the past few years I have collected notes on ferns of the Malay Peninsula, and have gathered them together here, with descriptions of five new species, *Davallia dimorpha, Diplazium insigne, D. latisquamatum, D. subintegrum,* and *D. velutinum.* The larger Diplaziums, inhabiting the mountain valleys from about 2,000 ft. upwards, still require much field study, and also careful comparison with the species of neighbouring countries. There are certainly several further additions to be made to the Peninsula species of this genus.

The notes here published are of various kinds. Most are additions to the recorded fern flora of the Peninsula, chiefly based on recent collections, but in some cases on redetermination of old collections. Some are critical notes on nomenclature, based either on my own study of type specimens, or copied from other sources, which are duly acknowledged. There are also field notes on many species, based on my own observations.

Acrostichum speciosum Willd. Spec. Plant. 4 Aufl. **5:** 117. 1810. Troll, Flora N. S. **28:** 301 – 327. 1933.

As pointed out by Dr. Troll, this species is quite distinct from *A. aureum,* with which it has been united by most authors. Watson, in *Malayan Forest Records No. 6,* pp. 152–157, gives an account of the two forms of Acrostichum occurring in Malayan mangrove; they are so distinct that local Malays have given them different names. The larger *A. aureum,* which may reach 4 metres in height, is called *Piai raya;* the smaller *A. speciosum* is called *Piai lasa.* Both species are abundant. *A. speciosum* occurs especially "where there are plenty of prawn heaps on which it can grow above the reach of the medium high tides."

Aplenium glaucophyllum v.A.v.R., Bull. jard. bot. Buitenz. II ser. VII : 6. 1912. *A. polystichoides* Bl. Mett. Asplenium 204. 1859 (nomen).

This species, described from Borneo (Nieuwenhuis no. 864), is not uncommon in the lowlands of the Malay Peninsula. The

specimens have hitherto been referred with doubt to *A. nitidum* Sw., to which species Mettenius referred as a variety the specimen of Korthals named *A. polystichoides* in Blume's herbarium. The species has been adequately described by van Alderwerelt van Rosenburgh, but some additional notes may be of interest. These are based on the material in the Singapore herbarium, and on a plant cultivated in the Botanic Gardens, Singapore. The cultivated plant occurred spontaneously on the base of an old Asplenium nidus on an African Oil Palm (*Elæis guineensis*), and was subsequently removed to a hanging basket.

The characteristic features of the species are the very long relatively narrow fronds (lamina commonly about 85 by 30 cm.), and the large pinnules, which are not pinnate but are commonly rather deeply incised once on the upper margin towards the base. Occasionally a specimen has the pinnules quite entire, except for the rather distant teeth (*e.g.* Burkill 17265 from Pekan, Pahang), while on very large fronds the largest pinnules may have several lobes, the lowest almost separated as a distinct leaflet. An extreme example of a lobed form is a specimen of Burkill's from Pulau Tioman (s.n., June 1915), but a quite comparable development is seen on the largest frond of the cultivated plant. The smallest fronds on the cultivated plant are quite small, but are fully fertile. The pinnules are almost all rounded at the apex, whereas on larger fronds the pinnules are gradually narrowed to an acute apex.

The stipes of young fronds are green, blackening with age; on old fronds the rachises are all black. The stipes and rachises are dull, not polished, and when young are clothed with very small narrow dark scales. The densely crowded scales on the apex of the rhizome are thin, dull purplish-brown, to at least 2 cm. long and 1 mm. wide. The colour of dried fronds varies from a rather pale olive to brown, and the colour of stipe and rachis from greenish-grey to black. Specimens in the Singapore herbarium are as follows. The Perak specimens are all small, and were labelled *A. nitidum* var. *obtusatum;* they match very closely the smallest fronds of the cultivated plant above mentioned.

SINGAPORE: Bukit Timah, Ridley s.n. 1906; do. 1907; Woodlands, Matthew s.n.; Mt. Austin, Ridley s.n. 1906. JOHORE: G. Pulai, Hullett s.n. Aug. 1880; Haji Senawi, Tempayan River, Ridley 10965; Tempayan River, Ridley 13286; Gunong Lambak, Holttum 9375; Mengkibol Station, Gossett 8314. SELANGOR: Batu Caves Woods, Ridley 8144. MALACCA: Harvey s.n. PAHANG: Pulau Tioman, Ridley s.n. 1889, Burkill s.n. June 1915; between Pekan and Ayer Tawar, Burkill 17265; Kuala Lipis, Burkill 17078; Tahan River, Ridley s.n. 27-9-1893.

KELANTAN: Sungei Keteh, Md. Nur 12037. PERAK: Gopeng district, King's Collector 8180; Upper Perak, L. Wray Jr. 3657.

Asplenium subnormale Copel. Perk. Frag. p. 183, pl. 4, f.B. 1905.

This species has not hitherto been recorded from the Malay Peninsula. It has been collected by Burkill on Pulau Tioman, S. Cape, close to the sea, no. 1036. I have seen specimens from Sarawak and British North Borneo.

Asplenium subscalare v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XX: 6 1915.

This species was described from a specimen originating from "Malacca", cultivated in the Botanic Gardens, Buitenzorg. The specimen was at first named *A. spathulatum* Bak. by v.A.v.R., whence the statement in his Handbook that *A. spathulatum* occurs in the Peninsula. A specimen of Scortechini's from Taiping, no. 129, labelled in his hand *A. abruptum* (a *nomen nudum*), is apparently the same as this species. Scortechini 243, from Maxwell's Hill, 3,000 ft., is perhaps also to be referred here; the plants are young.

Athyrium macrocarpum (Bl.) Bedd. F.S.I. t. 152. 1863. *Aspidium* Bl. Enum. 152. 1828.

This species has not hitherto been recorded as occurring in the Malay Peninsula. It has been found by me (no. 23462) on wet rocks at Cameron Highlands, beside the stream, with *Lindsaya cultrata*.

Athyrium nigripes (Bl.) Moore, Index XLIX. 1857. *Aspidium* Bl. Enum. 162.

This species was collected by Ridley on G. Berumban, no. 14001, and the specimen was named *Asplenium tenuifolium* by Beddome (Kew Bull. 1909: 423). I collected it later (no. 23275) it Cameron Highlands, where it was abundant in the forest near the stream at about 4,800 ft. altitude. This is the first published record of its occurrence in the Peninsula.

Bolbitis diversifolia (Bl.) Schott, Gen. ad t. 14. 1834.

Bolbitis subsimplex (Fée) Ching in C. Chr. Ind. Suppl. III: 50. 1934. with synonyms.

At the herbarium at Leiden I examined three specimens of Blume's, referred to this species, and I can see no difference from the common fern in the Peninsula which is clearly *Campium subsimplex* as described by Copeland (Phil. Journ. Sci. **37:** 356. 1928). One of Blume's specimens has simple fronds, the others pinnate. The species is common on rocks, usually by streams, in lowland forest throughout the Peninsula. Young plants always have simple fronds, and occasionally simple fertile fronds are produced.

Bolbitis Quoyana (Gaud.) Ching in C. Chr. Ind. Suppl. III: 49. 1934.

This species has not hitherto been reported as occurring in the Malay Peninsula. The only specimens which can now be so referred are from Bukit Timah, Singapore: Ridley 12569, Holttum 19799, Hullett s.n. March 1882. These specimens are not typical of the species, having pinnæ only very slightly lobed, but I do not know any other species to which they could be referred.

Cheilanthes varians (Wall.) Hk. Spec. Fil **2:** 89, t. 103A. 1852.

This species occurs in the north of the Peninsula, but has not hitherto been reported. Collections in the herbarium at Singapore are: KEDAH, Kampong Naka, Holttum 19814; Langkawi, Curtis s.n. I found the fern not uncommon, under the shade of rather open secondary forest.

Cyclopeltis crenata (Fée) C. Chr. Ind. Suppl. III: 64. 1934.

Hemicardion Fée Gen. 283, t. 22A, f. 1. 1852.

Specimens of Cyclopeltis from the Malay Peninsula have previously been referred to *C. semicordata,* the type of which is from tropical America. Fée's description and figure agree well with Peninsular plants which are quite distinct from the Philippine *C. Presliana.*

Cystopteris tenuisecta (Bl.) Mett. Ann. Lugd. Bat. **I:** 241. 1864.

This interesting species has lately been collected at Cameron Highlands (S.F.N. 31297, Holttum). Plants were found growing abundantly on the banks of a path cut in rather moist but lightly shaded forest at 5,000 ft. altitude. The same locality was visited before the path was cut, and no plants of the species noticed; they evidently found the moist newly cut earth a suitable habitat. No other plants were noticed in the neighbourhood, where the species is certainly not common, and no previous collections have been made in the Peninsula.

There are notes on *C. tenuisecta* by Posthumus in Bull. Jard. bot. Buitenzorg, Ser. III, vol. 13, p. 91. In the Malayan region it has been rarely collected, being known from N. Sumatra, a few localities in Java, and Luzon. It evidently requires a specialised habitat.

Davallia dimorpha Holttum sp. nov.

D. Griffithii affinis, differt: frondibus dimorphis, in sicco rufobrunneis, segmentis ultimis laminæ fertilis perangustatis.

Scales of the rhizome red-brown, shining, to 1 cm. long and 3 mm. wide above the peltate base, narrowed gradually to acuminate apex, edges subentire. *Stipes* of large fronds 30–40 cm. long, red-brown to dark purple-brown. *Lamina of sterile frond* deltoid, to about 45 cm. long and 30 cm. wide, pinnæ

subcontiguous, the segments of the pinnules contiguous or subcontiguous; pinnules separated by not more than half their width, more or less elliptical in shape, the edges bluntly serrate, apices rounded; texture coriaceous; colour of dried fronds rather light red-brown (often darker on older fronds); veins distinct, elevated; no spurious veins. *Lamina of fertile frond* to about 45 cm. long and 30 cm. wide, the pinnæ and pinnules of similar shape, size and spacing to those of the sterile frond, but the lamina of the pinnule-segments cut down to a narrow wing on either side of the veins, each segment terminating in a semicircular widened portion to accomodate the sorus; occasionally but not commonly the lamina prolonged into a tooth or horn beyond the sorus on one side; *sori* broader than long, often twice a broad, the indusium almost crescent-shaped, occupying almost the whole of the widened ends of the segments.

Type.—Pahang: Brinchang, Cameron Highlands, alt. 5,000 ft., S.F.N. 31289 (Holttum), in Herb. Singapore.

This remarkable species has only been found at Cameron Highlands, on the Main Range of the Peninsula. It is evidently allied to *D. Griffithii*, with which it agrees in the very broad sori, but differs very strikingly in the much-narrowed fertile pinnule-segments, which carry at their ends the almost crescent-shaped sori. The rather bright red-brown colour of dried fronds which are not too old when collected is also notable.

Diplazium insigne Holttum sp. nov.

Caudex brevis erectus. Stipites 1 m. longi, basin versus aculeati; aculei tenues, ad 2 mm. longi, primo paleas sordides angustas, ad 1.5 cm. longas, margine nigro-dentatas, ferentes, demum nudi. Lamia 1.5 m. longa, bipinnata. Raches minute paleaceæ; paleæ irregulares, majores dentatæ. Pinnæ infimæ 28 cm. longæ, 6.5 cm. latæ, basi angustatæ, medio ad costam lobatæ, lobi leviter obliqui, rotundati vel acuti, margine minute dentati. Pinnæ maximæ ad 60 cm. longæ, 16 cm. latæ, pinnatæ. Pinnulæ leviter obliquæ, omnes ad rachin adnatæ; pinnularum infimarum basis adnata 5 mm. lata, superiorum latior. Pinnulæ maximæ 9 cm. longæ, 2.3 cm. latæ, basi angulo 45° cuneatæ, e basi sensim angustatæ, apice 1.5–2 cm. multo angustatæ, margine leviter serratæ, textura firmiter herbaceæ, colore subtus pallidæ, supra atrovirides. Venulæ more D.accedentis anastomosantes, et soros ferentes.

Type.—Pahang, Fraser Hill, in Tras valley, 3,800 ft., Singapore Field Number 21635 (Holttum), in Herb. Singapore.

This species is in every way closely allied to *D. accedens* Bl., but is bipinnate (with slightly adnate pinnules) instead of simply pinnate. *D. stenochlamys* C. Chr. appears to be an allied but much smaller species. The type of *D. insigne* was a very fine large plant, inhabiting moist shady valley forest.

The mountain valleys of Malaya at 2,000–4,000 ft. altitude have been much less explored than the ridges, and, especially in ferns, contain a very rich flora. It is possible that *D. insigne* may be fairly widely distributed at such altitudes on the main range of the Peninsula. I found a young sterile plant, probably of this species, at about 2,000 ft. altitude near Ginting Simpah, some 25 miles south of Fraser's Hill, on the other side of the range.

Diplazium latisquamatum Holttum sp. nov.

Caudex brevis erectus. Frondes juveniles circinnatae squamis nigris rotundatis vel ovatis peltatis integris imbricatis vestitae. Stipites ad 90 cm. longi, basin versus vel omnino scabridi vel papillati, cum rachibus minute paleacei. Lamina ad 1.5 m. longa et 1 m. lata, tripinnatifida. Costae supra bialata, subtus squamis parvis subrotundatis paucis munitae, lamina cetera glabra. Pinnulæ sessiles basi late cuneatæ vel subtruncatae, apicem versus leviter angustatae, ad alam 2-3 mm. latam lobatæ, apice acuminatæ serratæ, textura firmiter herbaceae; lobi leviter obliquae, plerumque 4 mm. lati, oblingi, apice truncati, subintegri vel serrati. Venulae in lobis 5-6-jugatæ, simplices vel superiores furcatae. Sori dimidium inferum venularum solum occupantes; indusia persistentia.

Type. Pahang, Sungei Terla (Ulu Telom), S.F.N. 31311 (Holttum), in Herb. Singapore.

Other specimens.—Pahang: Cameron Highlands S.F.N. 23297, 23360, 31353, 31381. B. N. Borneo: Mt. Kinabalu, S.F.N. 25429; Clemens 27122, 32952, 32551, 33682, 32454, 32516.

The characteristic features of this species are the broad almost black imbricating scales on the young circinnate fronds, the tripinnatifid habit, and the sori confined to the basal half of the veins. In other characters there is much variation, due in part to the fact that plants immature in size may be fertile. The scales on the stipes, as the frond expands, are mounted on soft papillæ, which remain after the scales have fallen; but the degree to which these papillæ are developed seems to be very variable. S.F.N. 23297 has abnormally broad lobes to the pinnules, the ends rounded, and sometimes lobed again. In other characters it agrees with other specimens, and in view of the variation of cutting which clearly exists in the species, I can only regard it as a local variation. The Kinabalu specimens agree well, the only notable differences being that the scales tend to be ovate-acute, and the stipes on the whole more smooth.

This species is characteristic of moist shady valley forest in the neighbourhood of Cameron Highlands, at 4,000–5,000 ft. The plants often grow in very wet ground.

The Kinabalu specimens were at first identified with *D. atrosquamosum* (Copel.) C. Chr. This is clearly an error, in

view of the very broad scales, the scales of *D. atrosquamosum* being narrow.

A recent collection (S.F.N. 31193, Holttum) from an altitude of 2,500 ft. at Ginting Simpah (on the Main Range, south of Cameron Highlands) appears to belong to this species. The pinnules are broader than in any other collection, but the plants agree in other respects.

Diplazium subintegrum Holttum sp. nov.

Caudex brevis erectus. Stipites ad 80 cm. longi, basin versus squamis brunneis nitidis integris ad 1.5 cm. longis 2 mm. latis acuminatis vestiti, cetera nudi, straminei. Lamina pinnata, ad 70 cm. longa et 40 cm. lata, pinnæ ad 16-jugatæ; apex laminæ basin versus lobatus, cetera more pinnarum serratus. Rachis supra sulcata, in sulco minute papillata, subtus nuda. Pinnæ sub-basales maximæ (infimæ leviter breviores, non deflexæ), petiolutatæ 8 mm., ad 24 cm. longæ et 2.5 cm. latae, basi cuneatæ vel rotundatæ, margine serratæ, apice acuminatæ; textura subcoriaceæ; colore supra atrovirides, subtus pallidæ. Costæ subtus squamis linearibus brunneis paucis munitæ, cetera nudæ; venæ prope costam furcatæ, ramus acroscopicus simplex, ramus basiscopicus 1- vel 2-furcatus. Sori semper in venula acroscopica, e costa ⅔ – ¾ ad marginem, sedentes; rami venulæ basiscopicæ interdum soros breves ferentes. Indusia simplicia vel duplicia, lata, persistentia.

Type. Pahang, Sungei Burong, Cameron Highlands, 5000 ft. S.F.N. 31350 (Holttum), in Herb. Singapore. Frequent in forest.

Other specimens.—Pahang: Cameron Highlands, 4800 ft. S.F.N. 23338 (Holttum); G. Berembun, Ridley 13969; Fraser's Hill, 4000 ft. S.F.N. 8818 (Burkill and Holttum), 21539 (Holttum), G. Hose 15. Perak: The Cottage, Taiping, H. D. Hervey s.n. 1889; G. Batu Puteh, summit, Wray 314. Selangor: Bukit Kutu, 3,000 ft. Ridley 7844.

This species is allied to *D. Prescottianum* (Wall.) Moore, but differs constantly in the pinnæ never being in the least degree lobed nor auriculate at the upper base. It is frequent in the mountain forests on the Main Range, at least at Fraser's Hill and Cameron Highlands and is so constant that I cannot but regard it as a good species, though intermediates between it and *D. Prescottianum* appear to exist at lower altitudes. *D. Prescottianum*, founded on a specimen from Singapore, needs more study in the field. There are some specimens from Ginting Simpah (alt. 1500 ft.) which seem to connect it with *D. subintegrum;* but as *D. Prescottianum* has been rarely collected in true lowland forest we still have no proper understanding of its range of variation.

Diplazium velutinum Holttum sp. nov.

Caudex brevis erectus. Stipites plerumque 20 cm. longi, fusci, omnino pilis mollibus pluricellulis brunneis, basin versus squamis angustis nigris integris vestiti. Lamina anguste deltoidea, ad 25 cm. longa et 15 cm. lata, bipinnata. Raches pilis brunneis omnino dense velutinæ, squamis angustis nigris paucis intermixtis. Pinnæ liberæ 12-15-jugatæ. Pinnæ subbasales maximæ, ceteræ sensim reductæ, superiores in apicem brevem lobatum laminæ confluentes. Pinnæ maximæ ad 8 cm. longæ et 3 cm. latæ, plerumque 6 cm. longæ et 2 cm. latæ, subsessiles, e basi lata ad apicem sensim angustatæ; basin versus pinnatæ, apicem versus ad alam angustam lobatæ. Pinnulæ liberæ paucæ, ceteræ ad rachin plus minusve adnatæ. Pinnulæ vel lobi maximæ oblongæ, leviter obliquæ, margine serratæ vel lobatæ, apice rotundatæ, textura chartaceæ. Venulæ in pinnulis ad 7-10-jugatæ, simplices vel furcatæ. Sori e costa ½ – ⅔ ad marginem in venulis sedentes : in venulis furcatis ramum acroscopicum solum occupantes. Indusia sororum infimorum duplicia, cetera simplicia.

Type.—Pahang, Cameron Highlands (47th mile, Telom Rd) 4800 ft. S.F.N. 31221 (Holttum), in Herb. Singapore. Frequent in shady forest by rocky stream. Also Cameron Highlands, 4800 ft. S.F.N. 23428 (Holttum).

This species is closely related to *D. tomentosum* Bl., and there are a few specimens which are intermediate between the two species, but it differs very strikingly from typical *D. tomentosum* in the following characters : the pubescence on stipe and rachis is more abundant, and the lower pinnæ are always pinnate at the base, even in fronds of moderate size. The most extreme form, represented by one plant, has the pinnules lobed half way to the costa. In most cases the pinnules are serrate, the upper base tending to be auriculate.

D. tomentosum is a common fern of lowland forest in the Malay Peninsula, and there are a large number of collections in the Singapore herbarium. The range of variation is considerable, and in some cases the lower pinnæ are dissected to the costa. This extreme form is connected with *D. velutinum* by a few specimens from altitudes of about 3000 ft. In view of the constancy of *D. velutinum* in the neighbourhood of Cameron Highlands, I regard it as a mountain derivative of *D. tomentosum;* the intermediate specimens are possibly hybrids.

D. velutinum grows in the wettest and shadiest mountain forest, near streams.

I have to thank Dr. Carl Christensen for examining specimens, and for suggesting the name *velutinum*.

Dryopteris brunnea (Wall.) C. Chr. var. *glabrata* (Clarke).

Ching places this species in the genus Thelypteris (Bull. Fan. Mem. Inst. **6:** 272. 1936), in which he is doubtless right, but I am not yet in a position to segregate the Malayan species of this genus. The object of this note is to record the collection of the var. *glabrata* at Cameron Highlands, alt. 5000 ft. (Holttum s.n., May 1936). The specimens are small, but clearly referable here. The solitary plant seen was growing among rocks beside a stream in a recently made clearing. *D. oppositipinna* (see below) is clearly allied, but is much smaller with most of the pinnæ broadly sessile.

Dryopteris crenata (Forsk.) O. Ktze.

This widely distributed species has recently been collected for the first time in the Peninsula, on limestone at Gua Teja in Kelantan (S.F.N. 29682, Henderson).

Dryopteris dissecta (Forst). O. Ktze.

The first recorded collection of this species in the Malay Peninsula is Holttum 31292 from Cameron Highlands, alt. 5000 ft. The plants were found growing on the banks of a stream in shady forest. They are large, and agree with some Philippines specimens. They have the general aspect of Tectaria. For a note on this species *see* C. Christensen in this Bulletin, Vol. 7, p. 253.

Dryopteris glandulosa (Bl.) O. Ktze Rev. Gen. Pl. **2:** 812. 1891.

Aspidium glandulosum Bl. Enum. 144. 1828.

Dryopteris iridescens v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XI: 11. 1913.

Dryopteris malayensis C. Chr. Vid. Selsk. Skr. VII. **10:** 171, nota. 1913.

It appears to me that by the rules of nomenclature Christensen was wrong in transferring *Polypodium glandulosum* Desv. to Dryopteris (see Index Suppl. 33. 1913), when the name *D. glandulosa* was already occupied by Blume's species; the new name *D. malayensis* was therefore unnecessary. I have examined the type of *D. glandulosa* (Bl.) O. Ktze at Leiden, and I am of opinion that certain Peninsular ferns, which I had noted as being identical with *D. iridescens* v.A.v.R. are referable to this species. From description, it appears to me likely that *D. excrescens* Copel, and possibly also *D. Bartlettii* Copel. fall also within the range of variation of the species.

Blume's specimen at Leiden has the lower surfaces very uniformly glandular, with very short hairs on the veins, the upper surfaces uniformly appressed-hairy. Among Peninsular specimens the pubescence of the upper surface is very variable, even on the same plant; fertile fronds may be hairy when the

sterile are almost glabrous. Characters of pubescence can therefore not be relied upon in this species. A character which seems to be uniform and distinctive is the presence of spherical yellow glands on the sporangia; these glands are similar to those on the lamina. In the subgenus Abacopteris, the sporangia are nearly always setose or glandular in some characteristic way. Occasionally neither setæ nor glands are present; I have noted that this is the case in *D. lineata* (Bl.) C. Chr.

The Peninsula ferns of *D. glandulosa* are all of recent collection, and with one exception are from Pahang; there is also a specimen from Patani in Lower Siam. The duplicates of the specimens have been distributed variously as *D. lineata*, *D. malayensis* and *D. iridescens*. Older collections named and distributed as *D. glandulosa* are mostly *D. mirabilis* Copel. (*see* C. Chr. in Gard. Bull. S.S. **4:** 391. 1929). The specimens are as follows:

Malay Peninsula.—Negri Sembilan: Ulu Bendul, Holttum 9886. Pahang: Base of G. Senyum, Henderson 22289; K. Tembeling, Holttum 20533; Ulu Sungei Merapoh, Md Nur 11938; Tembeling, abundant near stream, Holttum 24702.

Sumatra.—Mentawi Islands: Siberut, Boden Kloss 13087.

Siam.—Patani: Banang Sta, Eryl Smith 1858.

Dryopteris lineata (Bl.) C. Chr. Ind. Fil.

Aspidium lineatum Bl. Enum. 144. 1828.

As this species has been confused with *D. glandulosa*, the specimens regarded as true *D. lineata* are enumerated below. *D. lineata* is clearly distinct in the absence of glands on the lower surface of the pinnæ, the absence of hairs on the upper surface, the somewhat pustular nature of the surfaces, the upper base of the pinnæ strongly auricled, the pinnæ almost entire. In the Peninsula the species has only been found in the neighbourhood of Cameron Highlands (on the Main Range, near the Perak-Pahang boundary). All specimens of which the altitude is given were collected in the mountains; but a specimen from Patani in Lower Siam was collected at a low altitude. The plants grow on rocks by forest streams. The specimens are:

Perak.—Gopeng, King's Collector 497; no locality, Scortechini. Pahang: Telom, Ridley 13097; Cameron Highlands, 4800 ft., Holttum 23362 and s.n. Patani: Banang Sta, 70 m., in earth on rock in large stream, Eryl Smith 2026; near Betong, on log in stream, 220–270 m., Eryl Smith 2027.

Dryopteris multisora C. Chr. Gard. Bull. S.S. **7:** 241. 1934.

This species, described from Mt. Kinabalu, B.N. Borneo, has been collected also in the Malay Peninsula, at Cameron Highlands, Holttum 23345, 23437 It belongs to a group of species which are only found in mountain forests.

Dryopteris oppositipinna v.A.v.R. MS in Herb. Bog.

Phegopteris oppositipinna v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XVI: 24 1914.

The type of this species was collected by Matthew on Mt. Singgalang, Sumatra (no. 518). I found it for the first time in the Malay Peninsula at Cameron Highlands (Holttum 23261), on wet rocks by a small stream in a rather open place at 4000 to 4,500 ft. altitude. The peculiar almost opposite broadly sessile pinnæ are very distinctive; the lower surfaces of rachis, costæ and lamina bear numerous short stiff pale erect hairs; similar hairs are also sometimes borne by the sporangia. There is no trace of indusium.

Dryopteris Parishii (Hk.) O. Ktze Rev. Gen. Pl. **2:** 813. 1891.

Nephrodium Parishii Hook. Spec. Fil. **4:** 131, t. 260. 1862.

Ridley does not record this species as occurring in the Malay Peninsula, but it was collected by Curtis at Langkawi (Nov. 1889), in crevices of limestone rocks; it has since been found on the mainland, in Perlis, at Bukit Lagi (Corner and Henderson 22876, 23135). Plants were brought to Singapore, and cultivated in pots under glass. The fronds died down periodically; the plants were then dried off and rested until new growth began. The resting habit appears to be obligatory in this species. The same is true of the allied *Dryopteris chupengensis* (Ridl.) C. Chr. Plants from the type locality were brought to Singapore by Messrs. Corner and Henderson in 1929, and grown in pots alongside *D. Parishii*. The two species are so closely similar in form of frond that I thought at first that *D. chupengensis* might be only a young stage. The two remained distinct however, and grew side by side for about three years. The largest dimensions of lamina attained by *D. chupengensis* under cultivation were 10 by 9 cm.

Dryopteris polita Rosenst. Fedde Report. **13:** 218. 1914.

A record of the occurrence of this species in the Peninsula was made in this Bulletin, Vol. 7, p. 252. It has been found only at Cameron Highlands (Holttum 23451), and was distributed as *D. sparsa*. I have seen the Leiden duplicate of the original collection of *D. polita* (Batakerland, F. Winkler; Rosenst. Fil. sumatr. exsic. 178); it is clearly the same as the Peninsula collection above cited.

Dryopteris pseudocalcarata C. Chr. Ind. Suppl. III: 95. 1934.

Aspidium ciliatum Wall. 1828 (nomen); *Nephrodium* Clarke Trans. Linn. Soc. Bot. **1:** 514. 1880 (non Desv. 1827).

Lastrea calcarata var. *sericea* Ridl. Journ. Mal. Br. R. Asiatic Soc. **4:** 65. 1926.

This species is very distinct from *D. calcarata*. It is common on mossy rocks beside mountain streams in the Peninsula, but does not occur in the lowlands; it has not been found in the south of the Peninsula.

Dryopteris sparsa (Ham.) O. Ktze Rev. Gen. Pl. **2:** 813. 1891.

The only specimen of this species I have seen from the Malay Peninsula is Holttum 25303 from Sungei Sengam, Perak, alt. 3500 ft., on rocks and damp ground near stream, in forest. This specimen is near var. *nitidula*, but the segments are more rounded than in Beddome's illustration. The Sungei Sengam is a small stream on the Perak side of the main range, just below the road up to Cameron Highlands. Ridley quotes a specimen of Matthew's (at Kew) from Maxwell's Hill.

Dryopteris stipellata (Bl.) O. Ktze Rev. Gen. Pl. **2:** 813. 1891.

Aspidium stipellatum Bl. Enum. 152. 1828.

I have examined Blume's specimen at Leiden, and find that some specimens from the Peninsula agree with it. The species is rather abundant by streams in shady valleys at Cameron Highlands; the young unexpanded fronds are covered with mucilage, through which the prominent pale aerophores appear. The surfaces beneath are glabrous, not glandular. A characteristic feature is the sudden narrowing of the apices of the pinnæ. The specimens at Singapore are:

PERAK: King's Collector 6345, 7174 (distributed as *D. heterocarpa*). PAHANG: Cameron Highlands 4800 ft. Holttum 23352. JOHORE: Gunong Muntahak, 600 ft., Holttum 19923.

Hymenophyllum exsertum Wall. Hook. Spec. Fil. **1:** 109, t. 38A. 1844.

This species has not hitherto been recorded as occurring in the Peninsula. The following specimens appear to belong to it; the indusia tend to be narrowed to the apex and entire, but there is much variation, and the sori are often aggregated in the apical portion of the frond. PAHANG: Gunong Tahan, Holttum 20738; Fraser's Hill, Holttum 21569.

Hypolepis bivalvis v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XVI: 19. 1914.

Christensen identified a specimen from G. Tahan as this species; I find that other specimens are also referable to it. All have been distributed as *H. tenuifolia*. The type of *H. bivalvis* is from G. Sago, Sumatra. Peninsula specimens are characterised by the presence throughout of viscid glandular hairs; in herbarium specimens these hairs are dried and their viscid character lost. The species has only been found in open places on mountain ridges.

PAHANG: G. Tahan, 6000 ft. Holttum 20763; Fraser's Hill, 4000 ft. Burkill and Holttum 8498, Holttum s.n. 1923, Eryl Smith 817, G. Hose 7.

Leptochilus decurrens Bl. Enum. 206. 1828.

This species is placed in *Campium* by Copeland (Phil. Journ. Sci. 37; 351). In his key to the genera concerned in the paper quoted, Copeland gives as a distinction between Campium and Leptochilus that the former has a creeping terrestrial rhizome, the latter being scandent or epiphytic. It may be interesting to record that I collected at Cameron Highlands a number of plants of *L. decurrens* (Holttum 23546) the rhizomes of which were scandent to the extent of at least one metre from the ground, on small trees by a stream in shady forest.

Leucostegia immersa (Wall.) Pr. Tent. 95, t. 4, f. 11. 1836.

This species has not been recorded as occurring in the Peninsula. There is a specimen in the Singapore herbarium, from Gunong Tahan (Ridley 16088).

Lindsaya javanensis Bl. Enum. 219. 1828.

L. flabellulata var. *gigantea* Hk. Spec. Fil. **1:** 211, t. 63c. 1846.

L. tenera var. *gigantea* Holttum Gard. Bull. S.S. **5:** 65. 1930.

Dr. O. Posthumus has called my attention to this species, and through the courtesy of Prof. Dr. H. J. Lam I have received a photograph of the type. I believe that it is identical with Hooker's variety above cited, of which I have seen the type at Kew. In my paper on the species of Lindsaya in the Malay Peninsula, I maintained this fern doubtfully as a variety of *L. tenera*. I believe that it is quite distinct; it should therefore bear Blume's name.

Lindsaya lucida Bl. Enum. 216. 1828.

L. Lobbiana Hk. Spec. Fil. **1:** 205, t. 62c. 1846. Holttum Gard. Bull. S.S. **5:** 61. 1930.

I have examined the type of this species at Leiden, and I can see no distinction from *L. Lobbiana* Hk., the type of which also came from Java. The Peninsula plants hitherto called *L. Lobbiana* are now therefore referred to *L. lucida;* there is however some possibility that they are distinct from the Java species.

Lindsaya nitens Bl. Enum. 217. 1828.

L. recurvata Wall. Hk. Spec. Fil. **1:** 222, t. 70A. 1846. Holttum Gard. Bull. S.S. **5:** 66. 1930.

I have seen the type of *L. nitens* at Leiden, and find that it is indistinguishable from *L. recurvata;* Blume's name should therefore be adopted for the species. The Leiden specimen has simply pinnate fronds, the lower pinnæ somewhat recurved and their upper edges incised.

Lindsaya nitida Copel. Phil. Journ. Sci. **6c:** 138, t. 21. 1911.

L. integra Holttum Gard. Bull. S.S. **5:** 67. 1930.

I have seen the type of Copeland's species in Brooks's herbarium at the British Museum. It is bipinnate, but in other respects agrees with my *L. integra*. Brooks's specimens was gathered at 3000 ft. on Mt. Penrissen, and it is possible at that this altitude the species grows to a larger size than by the lowland rivers of the Peninsula. Many species of Lindsaya have fully fertile fronds before they are large enough to bear fronds of fully mature size and branching. Christensen in Gard. Bull. **8:** 237 suggests that this species may be identical with *L. nitens* Bl. In my opinion the latter species is quite different, being identical with *L. recurvata* Wall.

Lygodium borneense v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XX : 29. 1915. Holttum, Journ. Mal. Br. R. Asiat. Soc. **6:** 16. 1928.

This remarkable fern, first discovered in Borneo, was collected by Boden Kloss on the Mentawi Islands, off the west coast of Sumatra. The gap in distribution has now to a small extent been filled by the discovery of plants in Johore, by Mr. E. J. H. Corner (Sungei Dohol, Ulu Sedili, Corner 26053). The plants were found in fresh-water swamp forest. This peculiar habitat may be part of the reason that the species has been so little collected. Fresh-water swamp forests are difficult botanical hunting grounds, and have been inadequately explored, a fact which is well shown by several recent discoveries by Mr. Corner.

Microlepia pilosula (Wall.) Pr.

A specimen recently collected at Cameron Highlands (S.F.N. 31293, Holttum) is closely similar to a specimen from Yunnan determined as *M. pilosula* by Mr. R. C. Ching. I have sent a specimen of the Cameron Highlands plant to Mr. Ching, who confirms the identification. The plant was found growing in the bed of a forest stream, under very moist conditions, at about 5000 ft. altitude. Its characteristic feature is the rather stout stiff pale glistening hairs on the rachises and veins beneath. A similar specimen from northern Siam (Doi Sutep, 1250–1400 m., Winit 1212), in the Singapore herbarium, was also found on moist rocks in a stream bed in evergreen forest. This is a great contrast to the dry open habitat favoured by the common *M. speluncæ*.

Nephrolepis barbata Copel. Perk. Frag. 178. 1905.

Christensen has seen the type of this species, and has identified with it specimens from the Peninsula; I am thus able to enumerate the specimens in the Singapore herbarium, which have hitherto been named *N. exaltata*. The species is characterised by relatively narrow fronds (to about 9 cm. wide), often of great length, the pinnæ close, strongly falcate, usually

drying rather pale green. The plants nearly always grow on rocks, or sometimes on trees, their fronds being pendulous, sometimes well over two metres in length.

PENANG: Waterfall, Ridley 7038. PERAK: Bujong Malacca, Ridley 9607; Relau Tujor, L. Wray 2207; Larut, King's Collector 5229, 5220. NEGRI SEMBILAN: Ulu Bendul, Holttum 9820. SELANGOR: Gua Batu Woods, Ridley s.n. Dec. 1896. PAHANG: Tahan River, near K. Teku, Holttum 20807; Gua Tipus, Chigar Perah, crevices in limestone, Henderson 19405.

There are also specimens from Siam.

Ophioglossum simplex Ridl. ex Bower, Nature **64:** 617. 1901.

This curious species, originally reported from Sumatra, has been found on the summit of Gunong Panti, Johore. It was growing on the ground in the shade of a thicket which had grown up on the summit after clearing. This is the first record for the Peninsula.

Osmunda javanica Bl. Enum. 252. 1828.

The first collection of this species in the Peninsula was made by me in the valley of the Sungei Sengam, Perak (Holttum 25302), at about 3500 ft. above sea. The plants were quite abundant in shady forest, on the valley-sides. They are in appearance very like *Cyathea brunonis*, for which reason they may have been overlooked in the past, but when fertile they are naturally quite unmistakable. The very young unexpanded fronds are covered with mucilage, in the manner of Plagiogryria, but there are no aerophores. The pinnæ are articulate, another resemblance to *C. brunonis*. Plants are growing quite well in cultivation in Singapore and have produced spores. It has since been discovered that *Osmunda javanica* is very abundant beside the Telom river at about 3900 ft. alt., growing in large clumps on rocks, and also in the forest near by.

Plagiogyria adnata (Bl.) Bedd. F.B.I. t. 51. 1865.

No record has been made of the occurrence of this species in the Peninsula. There is however a collection of Mr. Ridley's, from Gunong Tahan (Ridley 16002); this was distributed as *Polybotrya appendiculata* var. *subintegra*.

Polypodium albidosquamatum Bl. Enum. 132. 1828.

This species has never been recorded as occurring in the Malay Peninsula. It was collected by Kunstler in Perak, and was distributed as *Polypodium leiorhizon* Wall. The specimen in the Singapore Herbarium is labelled "King's Collector, no. 10703", and bears no exact locality. The species is of wide distribution, and it is rather surprising that it has only once been found in the Peninsula. The Singapore specimen has only fertile pinnæ, which are rather unusually long.

Polypodium grandidentatum (Cesati) Bak. Ann. Bot. **5:** 479. 1891.

P. dilatatum var. *grandidentatum* Ces. Att. Ac. Nap. **7,** 8 : 27. 1876.

This species, allied to *P. Hancockii* (*see* below), appears to be quite distinct. In the Peninsula it is a lowland plant, whereas *P. Hancockii* has only been found at about 5000 ft. *P. grandidentatum* when mature has much larger fronds than *P. Hancockii,* and also differs in having the lower lobes gradually reduced in size, whereas in *P. Hancockii* the lowest lobes are the largest. *P. grandidentatum* was described from a plant from Matang, Sarawak, which I have seen. The species usually grows on rocks, but in my experience has not the stiffly erect habit of *P. Hancockii.*

Polypodium Hancockii Bak. Journ. Bot. 1885 :106.

P. euryphyllum C. Chr. Index.

In the Peninsula this species has only been collected at Cameron Highlands (Holttum 23501); the specimens formerly distributed as *P. dilatatum* Wall. or *P. euryphyllum* are *P. grandidentatum. P. Hancockii* is found on mossy rocks beside small mountain streams at about 5000 ft. altitude, in shady places. The rhizome clings to the rocks and the fronds are erect.

Polypodium insigne Bl. Enum. 127. 1828.

This species has been collected in the Peninsula, but not reported. It is apparently very variable in the width of the pinnæ; in this character Peninsula specimens agree well with the type. The species appears normally to grow on rocks beside forest streams, but two specimens collected at Fraser's Hill were climbing trees to a few feet from the ground. Ridley's specimens were distributed as *Aspidium decurrens.*

Pahang : Telom River, Ridley 13978; Fraser's Hill, G. Hose 9, Holttum 8789. Perak : Sungei Sengam, 3500 ft., Holttum s.n. 1931.

Polypodium normale Don, Prodr. Fl. Nepal. 1. 1825.

This species has not yet been recorded as occurring in the Malay Peninsula. I collected it at Cameron Highlands, at 4800 ft., on a tree on the edge of the forest (Holttum 23363). The specimen appears to me quite identical with *P. normale* from Assam, and also with *P. subnormale* v.A.v.R. from Sumatra.

Polypodium malaicum v.A.v.R. Handb. 577. 1909.

Polypodium sessilifolium Hk. Spec. Fil. **4:** 168, pl. 268A. 1863.

The question of the type of this species is a rather difficult one. Hooker in his original description quoted three specimens, but did not indicate a type. The specimens are : Luzon, Cuming

382; Penang, Sir W. Norris; Java, Blume. An inspection of the sheets at Kew indicates that Hooker's figure was drawn from another specimen not cited by him, namely Cuming 222 from Luzon. This figured specimen is on the same sheet at Kew as Cuming 382 and Norris's plant from Penang; both of the latter are very much smaller than the figure, which agrees closely with Cuming 222. Examination of the lists of Cuming's numbers show that Hooker made a mistake in regarding no. 382 as from Luzon; it was actually collected in Malacca, and it is certainly identical with *P. subevenosum* Bak., the type of which is from Penang.

Hooker's description indicates that he included Cuming 222 in his species (he gives the length of the fronds as 3–8–9 inches); in fact, the species is a composite one, including *P. subevenosum* from the Peninsula and a distinct species, represented by Cuming 222, from Luzon. There are clearly two alternatives: either we may regard Cuming 382 as the type of *P. sessilifolium* Hk., in which case that species becomes a synonym of *P. subevenosum* Bak. and a new name is required for the Luzon plant; or we may select Cuming 222 as the type of *P. sessilifolium* Hk., in which case the species is quite distinct, and should bear the name *P. malaicum*. I prefer the latter alternative, more especially as it agrees with the treatment which has usually been given to the species. Christensen refers to the species in this sense in this Bulletin, vol. 7, p. 292, and remarks that a specimen from Kinabalu is identical with Copeland's Pterid. Philip. exsic. 141, distributed as *P. sessilifolium*, and notes the presence on both of setose sporangia. Cuming 222 has not been examined to find out whether it has this character.

My proposal is therefore to regard Cuming 222 as the type of this species, excluding the Peninsula specimens quoted by Hooker (Cuming 382 and Penang, Norris); it is much larger than *P. subevenosum* and most of the veins are forked, with a probable distinguishing character in the setose sporangia.

Polystichum prolificans v.A.v.R. Bull. Jard. bot. Buitenz. III ser. **2:** 170. 1920.

A species of Polystichum is quite common on the large granite boulders in shady gullies on Penang Hill; the same species has been collected in Perak (King's Collector 6258). These plants have been named *P. biaristatum* Bl. (Ridley, Journ. Mal. Br. R. Asiat. Soc. **4:** 61. 1926) I have examined the type of *P. prolificans* (from Sumatra) and find that the Perak specimen is identical; the Penang specimens in the Singapore herbarium are all smaller than the type, but are otherwise similar.

Pteris platysora Bak. Journ. Bot. 1880: 211.

A specimen from Gunong Kerbau (Haniff 14743) in the Singapore herbarium appears to be referable to this species, the

type of which is from Sumatra. The specimen represents a large and handsome plant, quite unlike any other Pteris so far known in the Peninsula. This species is apparently very near *P. insignis* Mett.

Pteris scabripes Wall. Hook. Spec. Fil. **2:** 165. 1858.

The type of this species is Wallich no. 94 from Penang. As stated by Hooker, it is very near the widely distributed *P. cretica* L., and I am not in a position to judge how good its claims may be to rank as a district species. The sterile pinnæ are very close together, so that the frond is often almost flabellate; the edges of the pinnæ are finely serrulate throughout, by which this species is clearly distinguished from the following. The species is rather local in its occurrence, though sometimes fairly abundant. Specimens from the Peninsula are:

Selangor: 15th mile Pahang Track Ridley s.n. July 1897. Penang: Jerantut, Holttum 24791; Tembeling, Holttum 24690. Perak: Upper Perak, growing on rocks, 300 ft., L. Wray Jr. 3699; Telok Pinang, Ipoh, Ridley s.n. Oct. 1898. Kedah: Burau Bay, Langkawi, Ridley 15789; Langkawi, Curtis s.n. Sept. 1890; Foot of G. Raya, Langkawi, Curtis 3381.

Pteris venulosa Bl. Enum. 209. 1828.

It appears probable that the specimens from the Peninsula hitherto referred to *P. pellucida* Pr. are *P. venulosa* Bl. I could not find the type of the latter species at Leiden, but saw several other specimens from Java, with which Peninsula specimens agree, with the exception that most of the latter have fewer pairs of pinnæ, and some have the pinnæ so close as to be almost digitate. In habit, Peninsula plants agree rather closely with *P. scabripes*, with which they have been confused. They differ very strikingly however, in having the margins of the sterile pinnæ entire and slightly wavy or crisped, except towards the apex, where they are broadly and rather bluntly toothed; this contrasts with the pinnæ of *P. scabripes*, which are finely serrate throughout. Peninsula specimens are as follows:

Johore: G. Pulai, Hullett s.n. Aug. 1880; G. Pulai, rocks by the stream, Ridley s.n. Dec. 1905; G. Berhidong, on wet rocks 1,800 ft. by stream, Holttum 10995; G. Pulai, G. A. Best 7721. Negri Sembilan: G. Angsi, 2000 ft. Md. Nur 11582. Selangor: C. Curtis s.n. May 1902. Perak: Larut, 2800–3000 ft., King's Collector 3811; Maxwell's Hill 3000 ft. Scortechini 405: 444. Penang: Government Hill 2000 ft. Haniff 7590; Hullett s.n. December 1881.

Quercifilix zeylanica (Houtt.) Copel. Phil. Journ. Sci. **37:** 409. 1928.

This species, though of wide distribution, has never been collected on the mainland of the Malay Peninsula. It has been found on the island of Pulau Tioman, where it was collected

at the South Cape, nestling in rocks, by Burkill in 1915 (Burkill 1034).

Rumohra aristata (Forst.) Ching, Sinensia **5:** 50. 1934.

Under *Polystichum aristatum,* Ridley (1926, p. 61) quotes his no. 15966 from Gunong Tahan; this is however *R. puncticulata* (*see* below). The only collections of *Rumohra aristata* known to me from the Peninsula are as follows. In one case plants were found growing on rocks beside the Tahan river at about 500 ft. altitude (Holttum 20805); these were small, but quite similar to specimens from southern China. The other collection (Holttum 24999) was from a more shady position, from rocks beside a small forest stream near the Sungei Sengam, Perak, at about 3000 ft. (just below Renglet); the fronds of this were larger and thinner in texture.

Rumohra puncticulata (v.A.v.R.) Holttum comb. nov.

Polystichum puncticulatum v.A.v.R. Bull. Jard. bot. Buitenz. III ser. **2:** 171. 1920.

I have seen the type of this species, from Sumatra, and I believe that specimens from the Peninsula (also Mount Kinabalu) are also referable to it. It is allied to *R. speciosa* (Don) Ching. The Peninsula specimens are from G. Tahan and G. Kerbau, our two highest mountains. They are : G. Tahan, Ridley 15966, Holttum 20779; G. Kerbau, Haniff 4033.

Stenosemia pinnata Copel. Phil. Journ. Sci. Suppl. II: 146. 1906.

All Peninsula specimens of Stenosemia appear to agree with this species rather than with *S. aurita,* to which they have been previously referred. Typical specimens of *S. aurita* from Java have triangular fronds, the lowest pinnæ largest, and the lowest basiscopic segments longest. In most Peninsula plants the lowest pinnæ are not much larger than the next, and the lowest basiscopic segments of the lower pinnæ are small, the largest ones being at about one-third towards the apex. There is some variation, but the Java form is never found. Stenosemia appears to be confined to limestone rocks in the Peninsula. It is well established in shady rockeries at the Singapore Botanic Gardens, where it grows on old coral and reproduces freely. The type of *S. pinnata* is from Mindanao, and a study of the geographic distribution of the forms of Stenosemia would be interesting.

Tectaria decurrens (Pr.) Copel.

This species has not yet been collected in the Malay Peninsula. The specimens so named by Ridley (1926, p. 79) are *T. crenata* Cav. and *Polypodium insigne* Bl.

Tectaria Keckii (Luerss.) C. Chr. Index Suppl. III: 181. 1934.

Aspidium Luerss. Bot. Centralbl. **11:** 76. 1882.

The type of this species is from "Klang, bei den Gua Batu". I have not seen it, but it seems to me highly probable that it is

the same as *Aspidium amplifolium* v.A.v.R., a common fern of limestone rocks in the Peninsula, formerly referred to *A. subtriphyllum*. It is certainly allied to *A. subtriphyllum*, but is a much large fern. Kehding collected both in the Peninsula and Sumatra, and the locality Gua Batu is probably the same as Batu Caves, near Kuala Lumpur.

Tectaria Maingayi (Bak.) C. Chr. Index Suppl. III: 182. 1934.

For sysnonymy of this species, *see* Holttum in this Bulletin, Vol. 5, p. 207.

Tectaria ternifolia (v.A.v.R.) C. Chr. Index Suppl. III: 185. 1934.

Aspidium v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XI: 3. 1913.

The type of this species is a specimen collected by Matthew at Gopeng. The species has since been collected in Pahang, as a locally common terrestrial fern in forest on "Raub Series" rocks. The fertile fronds are produced seasonally, on much longer stipes than the sterile. Specimens seen are: Tembeling, Holttum 24693; Henderson 21682; G. Senyum, Henderson s.n. Ridley quotes a specimen from Pekan as *Aspidium ternatum;* this species has not otherwise been found in the Peninsula, and the specimen is perhaps *T. ternifolia.*

Trichomanes exiguum (Bedd.) Baker, Syn. Fil. 464. 1874.

Hymenophyllum Bedd. F.B.I. pl. 275. 1868.

A specimen (s.n.) gathered by me at Ginting Simpah appears to be this species, which has not hitherto been recorded as occurring in the Peninsula. The plants were growing on a large boulder beside a stream in forest near 2000 feet above sea level.

Trichomanes radicans Sw.

No specimen of this species, even widely interpreted as in Copeland's recent work (Phil. Journ. Sci. **51,** p. 213), has hitherto been found in the Malay Peninsula, the nearest being a specimen from Siam. A recent collection from Cameron Highlands (S.F.N. 23466, Holttum) fills this gap. The plants are small, with fronds to 7 cm. long.

Vittaria malayensis Holttum Gard. Bull. S.S. **4:** 409. Jan. 1929.

Apparently *V. stenophylla* Copel. from Luzon (name published in October 1929) is the same as *V. malayensis;* there is a specimen of Copeland's (Pterid. Philip. exsicc. 122) in the Singapore herbarium and I have compared it with Malayan specimens. *V. malayensis* is not uncommon as an epiphyte on the main range of the Peninsula.

FURTHER NOTES ON STENOCHLÆNA, LOMARIOPSIS AND TERATOPHYLLUM.

By R. E. Holttum.

In this Bulletin, Vol. 5, nos. 9-11 (1932), I gave an account of the above genera, based on all the material then available to me. It subsequently appeared that the bulk of the specimens of "Stenochlæna" from the Herbarium of the Bureau of Science, Manila, had previously been sent to the U.S. National Herbarium on loan and were not with the material I had for study from Manila in 1932. Some of the Philippine collections were represented by duplicates at Buitenzorg, and in the Singapore herbarium, but a great many were not. I was therefore very glad of the opportunity of examining the full Manila collections, which has been possible through the courtesy of Dr. W. R. Maxon of the U.S. National Herbarium and Dr. Quisumbing of the Philippine National Herbarium. At the same time, Dr. Maxon sent me on loan the specimens from the U.S. National Herbarium, which in some cases supplied further information.

The result of the examination of these additional specimens is that I am able to add a few notes about the Philippine species of the three genera, and I am able also to correct a misapplication of the name *Lomariopsis leptocarpa*. My thanks are due to Dr. Maxon and Dr. Quisumbing, and also to the authorities of the herbaria at Kew and the British Museum, where I discovered some further specimens during my leave to Europe in 1934.

This paper contains the new combination *Teratophyllum leptocarpum* (Fée) Holttum.

STENOCHLAENA.

S. fraxinifolia Presl, Epimel. 164. 1849.

The type of this is Cuming 347 from Negros. There is a specimen (including fertile frond) in the British Museum herbarium and another in the U.S. National Herbarium; I can see no distinction from *S. palustris*. The characters mentioned by Presl seem to me of little diagnostic value.

S. juglandifolia Presl, Epimel. 164. 1849.

Lomaria? juglandifolia Presl, Rel. Hænk. **1:** 52.

Stenochlæna Milnei Und. Bull. Torr. Bot. Cl. **33:** 38. 1906.

The type of this species is a specimen of Hænke's from Luzon; I have not seen it. In *Epimel. bot.* Presl quotes also Cuming 133 *partim*. Cuming 133 is also quoted under *Stenochlæna scandens* (the species now called *S. palustris*) both by Presl and John Smith (Journ. Bot. **3:** 401).

All the specimens of Cuming 133 which I have seen (in the herbaria of Kew, the British Museum, and Dr. E. B. Copeland) are identical, and are intermediate in character between *S. palustris* and *S. laurifolia*. There are some remarks on the subject in this Bulletin Vol. 5, p. 258. I now find that these specimens agree with *S. Milnei*, a species overlooked when preparing my former paper, the type of which I have examined at Kew. The question therefore arises as to whether *S. juglandifolia* and *S. Milnei* are synonymous.

The principal characters distinguishing *S. Milnei* from *S. palustris* are the broadly rounded bases of the sterile pinnæ, and the width (5 mm.) of the fertile pinnæ. Presl gives the first of these as distinctive of *S. juglandifolia;* as regards the fertile pinnæ he states that they have a broad margin on either side of the narrow costal fertile zone, but he does not give any measurements. Presl may perhaps have had a young fertile frond. These facts, together with Presl's citation of Cuming 133 seem to me sufficient evidence for accepting the identity of the two species in question. The only doubtful point in Presl's citation of Cuming 133 under *S. scandens*; it is possible that this was copied from John Smith.

S. juglandifolia is intermediate in character between *S. palustris* and *S. laurifolia*. When preparing my former paper I was in some doubt how to treat intermediate specimens, and finally referred them to *S. palustris,* as they were clearly not *S. laurifolia,* which is a very well-marked species as compared with the variable *S. palustris.* I think however that *S. juglandifolia* is sufficiently distinctive to warrant specific separation. Its intermediate character is seen in the following points:

	S. palustris	*S. juglandifolia*	*S. laurifolia*
Base of sterile pinnæ	cuneate	broadly rounded	cordate
articulation of pinnæ	complete	partial	not articulate
width of fertile pinnæ	2–3 mm.	5 mm.	7–10 mm.
vascular bundles in stipe	to about 40	intermediate	over 100
spores	tuberculate	irregular broken ridges	parallel ridges

The statement about the spores of *S. juglandifolia* is based on an examination of the spores of Milne 518 (the type of *S. Milnei*); this specimen was referred by Hooker (Spec. Fil. **5:** 251) to *S. laurifolia.*

The known distribution of *S. juglandifolia* is as follows: the Philippines, New Guinea and the Solomon Islands. It therefore corresponds approximately with that of *S. laurifolia* and is within the range of *S. palustris*. It is possible that *S. juglandifolia* represents a natural hybrid between the other two species. The Philippine specimens referred to *S. juglandifolia* are as follows: LUZON. Cuming No. 133 (K, B.M., W, Copel.), Irosin (Mt. Bulusan), Prov. Sorsogon, Elmer 16253 (W, M). Los Banos, Elmer 18242 (Copel., M, W). MINDANAO. Camp Keithley, Lake Lanao, M. S. Clemens 944 (M). Butuan Subprov. Fenix 15907 (W).

S. laurifolia Presl, Epimel. 164. 1849.

I have examined the sheets of Cuming 226 (the type collection) at Kew, and find that glands are present at the bases of the pinnæ as in *S. palustris*. Hooker (Spec. Fil. **5:** 251) remarks on the absence of glands as a character distinguishing this species from *S. palustris;* apparently he failed to observe them. Owing to the broad cordate bases of the pinnæ of this species, the glands are not so obvious as in *S. palustris*. Additional specimens of *S. laurifolia* are:

LUZON. Guintacutan, Tayabas, Foxworthy and Ramos 13170 (M).

MINDORO. Bulalacas, J. Bermejos 1545 (M).

LOMARIOPSIS.

L. spectabilis (Kze) Mett. Fil. Lips. 22. 1856.

Lomaria Kze Bot. Zeit. 1848: 144.

Lomariopsis leptocarpa Holttum, Gard. Bull. S.S. **5:** 270, not of Fée.

In my paper above quoted I followed Underwood in regarding *Lomariopsis spectabilis* as synonymous with *L. leptocarpa*. Fée's figure of the latter agrees very well in shape of pinnæ with specimens of the former from Java. When however I examined the type of *L. leptocarpa* (Cuming 132), I found it to be a Teratophyllum; it is in fact *T. Williamsii* Und. A close inspection of Fée's figure reveals the articulation of the terminal pinna; inspection of the specimens reveals also the great difference in texture and colour. This being the case, another name is needed for the species of Lomariopsis, and fortunately such a name exists in *L. spectabilis*.

The type of *L. spectabilis* is from Java. I have not seen it, but I have seen a number of other specimens from Java, and I think there can be no doubt of the identity with this species of the specimens quoted in my former paper. I have seen one more Philippine specimen (Mt. Mariveles, Bataan Prov., Luzon, Topping 423). This is fully pinnate, but small.

There are no specimens from the Philippines which equal in size those from Java, and there is an almost complete lack of specimens from the intervening area. The Philippine specimens however are not sufficiently distinct to warrant the founding of a new species. The whole question of the distinction between species in the genus Lomariopsis is a very difficult one, and must wait for much more evidence in the shape of collections and field observations.

L. Brackenridgei Carr. in Seeman, Flora Vitiensis, 373. 1873.

As a synonym to this species should be added *Gymnogramme subtrifoliata* Hook., formerly included by me under *L. oleandrifolia*. I have seen the type of Hooker's species at Kew, and in texture and colour it clearly resembles *L. Brackenridgei* rather than *L. oleandrifolia*, which has very coriaceous fronds of a peculiar brown colour. The type in question is a trifoliate frond of a young plant; its reference to *L. Brackenridgei* is therefore not quite certain, but there is no other recorded species from Fiji to which it could belong. The name *Lomariopsis subtrifoliata* is already occupied for Copeland's Philippine species, so that there is no question of this name replacing *L. Brackenridgei*, which is fortunate, as Hooker's type is from a very young plant, and also the validity of his original description, with two question marks, is perhaps open to doubt.

TERATOPHYLLUM.

T. Clemensiæ Holttum, Gard. Bull. S.S. **7:** 262. 1934.

This species is closely allied to *T. rotundifoliatum* (Bonap.) but differs in the bathyphylls, which are all simply pinnate, and in the narrower fertile pinnæ (about 5 mm. wide). The original specimens were obtained on Mt. Kinabalu, British North Borneo. A further collection from Palawan has now to be reported, consisting of the characteristic bathyphylls only. It is Merrill's No. 862 from San Antionio Bay, Feb. 1903 (Philippine National Herbarium).

Teratophyllum luzonicum Holttum Gard. Bull. S.S. **5:** 297. 1932.

This species was based on a single specimen from Luzon; the material did not include bathyphylls. A relationship to *T. rotundifoliatum* seemed probable, but was not proved owing to the incomplete specimen. Among the further Philippine collections from the herbaria at Manila and Washington which I have since examined are some from the island of Palawan which seem to be referable to this species. They consist of bathyphylls from the youngest stage onwards to sterile acrophylls, all associated together but without fertile fronds; the feature in common with the Luzon plant is therefore sterile acrophylls. It is a little uncertain in this genus to base a

determination of an incompletely known species on one stage alone, and collections of bathyphylls from the type locality of *T. luzonicum,* definitely associated with typical acrophylls, are necessary to give a final proof of identity. I think however that the identity is extremely probable; if it fails, then the Palawan plant must be a new species.

The youngest stages (simple fronds) are shown by Merrill's No. 770. The fronds are closely similar to those of *T. rotundifoliatum* and *T. Clemensiæ* (*see* this Bulletin Vol. 5, p. 285, fig. 37, and Vol. 7, p. 263, fig. 1). The basal lobe is perhaps more pronounced than in the other species. No. 771 shows transition (on the Washington sheet) from the youngest stage to small bipinnate bathyphylls; the latter are up to about 4 cm. long and 1.6 cm. wide, the pinnules obovate, to almost 2 mm. long. No. 773 has both sterile acrophylls and bathyhylls, and in the Kew specimen both are attached to the same rhizome. The bathyphyll on the Kew specimen is large, tripinnatifid (almost tripinnate), the segments as in the small fronds. Foxworthy's specimen has rather large bipinnate bathyphylls. The distinction from the bathyphylls of *T. aculeatum* is the obovate shape of the segments, which are rarely bifurcate.

The sterile acrophylls associated with these bathyphylls agree well with those of the type callection of *T. luzonicum,* the difference being that some of the pinnæ are a little larger. The specimens are:

PALAWAN (Paragua). E-wi-ig- River, 1700 ft. Merrill 770 (W, M). 701 (K, W, M), 773 (K, W, M). Rio Balsajan, 700 m. Foxworthy 577 (M).

T. leptocarpum (Fée) Holttum comb. nov.

Lomariopsis leptocarpa Fée, Acrost. 69, t. 29. 1845.

Teratophyllum Williamsii Holtt. Gard. Bull. S.S. **5:** 292, with synonyms. 1932.

As mentioned above, I have discovered that *Lomariopsis leptocarpa* Fée, represented by the type Cuming 132, is a Teratophyllum, and is identical with the species later named *Stenochlæna Williamsii* by Underwood. Fée's name must therefore be used, as the oldest. The specimen at the British Museum consists of an adult sterile frond, agreeing in all respects with *T. Williamsii.* No bathyphylls were represented in the collection, for which reason Fée included the species under the heading "frondibus homomorphis". As the shape of the pinnæ is very like that of the pinnae of *Lomariopsis spectabilis* the discrimination of the two species from figures is not easy.

Among the Philippine specimens which I have recently examined are a few which show the early stages and normal bathyphylls more completely. The youngest stage is still not

represented, but there are bathyphylls of only 2.8 cm. long; these show no signs of a dimidiate condition. The small bathyphylls show the same character of narrowly linear ultimate segments as the larger bathyphylls; only the very youngest stages have rather broader segments, still with parallel sides. Nearly all specimens, bathyphylls included, show the pronounced red colour on drying. Additional specimens are:

LUZON. Prov. Bataan, Curran 19152 (M), C.B. Robinson s.n. Aug. 1908 (M), P. T. Barnes 85 (M, W). Apayao subprov. Fenix 28276 (M).

T. aculeatum (Bl.) Mett.

There are a number of further collections from the Philippines, chiefly of bathyphylls, which indicate that this species is typically represented in the Philippines, though there are no very young or fully dimidiate stages.

One collection (Rizal Prov., Ahern's Collector, Forestry Bureau No. 2695) has very remarkable large normal bathyphylls, to 16 cm. long and 8 cm. wide. The general character of the pinnæ is similar to *T. aculeatum*, but there are no other specimens at all comparable in size. It is possible that they represent another species.

AN EARLY TERTIARY RELICT IN MALAYA, EUPHORBIA RIDLEYI nom. nov., descr. emend. (E. SYNADENIUM RIDL.) AND ITS POSITION IN THE LINNEAN GENUS.

By Leon Croizat,

New York.

A singular *Euphorbia* was presented by Ridley (Journ. Roy. As. Soc., Str. Br., No. 61 : 36, 1912) as follows :—

"*Euphorbia Synadenium* n. sp. A shrub about 2 feet tall, stem smooth brownish rather succulent. Leaves alternate oblanceolate spatulate subacute or blunt narrowed to the petiole fleshy, green, nerves invisible, 4 inches long 1½ inch wide, petiole ½ inch long. Inflorescence solitary or in pairs 1 male and 1 female axillary. Male, peduncle ⅛ inch long thick with two short ovate bracts purple pink. Involucre as long as pink lobes 5 thick semiorbicular light green punctate. Glands separate truncate oblong narrowed at the base, apex laciniate pink ten. Flowers numerous. Stamens solitary, filament thickened at the base above filiform surrounded by a fimbriate calyx of narrow white linear lobes about 8, anther cells globose separate. Female involucre smaller subangled with 2 dark pink lobes much shorter not expanded greenish yellow, glands flat incurved laciniate pale green. Pistil solitary surrounded with pale green laciniate calyx, ovary subglobose shortly stalked. Styles three subulate not plumed twisted together.

Penang Hill : near the Waterfall : Selangor : Langat.

In rocky woods. I have this curious plant in cultivation in the Botanic Gardens in Singapore.

Baillon described a species of *Synadenium* as *Euphorbia Synadenia* but this has been referred to its genus *Synadenium*, so that the above name will stand."

The description, no doubt, suffers on account of careless typesetting. A carefully edited rearrangement of it (Fl. Mal. Pen., 3 : 180–181, 1924), however, is barely more intelligible to the average taxonomist; the revised description is as follows :—

"*E. synadenium* Shrub about 2 ft. tall. Branches rather succulent, brown. Leaves alternate oblanceolate spathulate sub-acute or blunt, fleshy dark green : nerves invisible; 4 in. long, 1.5 in wide; petioles 5 in long. Involucres solitary unisexual. Male on a peduncle .12 in. long with 2 ovate purple-pink bracts; involucre pink, lobes thick semiorbicular, green. Glands 10 truncate oblong laciniate pink. Stamens

solitary surrounded by a calyx of about 8 white linear lobes. Female involucre smaller with 2 pink lobes, glands flat incurved green. Pistil surrounded by a laciniate green calyx. Ovary subglobose stipitate. Styles 5 subulate. Hab. rocky woods, local, Selangor, Langat (Ridley). Penang Hill near the waterfall (Curtis, Ridley) Native name: *Poko Sesudu Bukit.* I have only seen this plant about 2 ft. tall. Mohammed Haniff reports it as growing to 6 to 8 ft."

In both accounts the terminology is Ridley's own and highly unconventional. So much, of course, does not in itself call for comment or censure, but any one familiar with the genus is puzzled by the mention of 10 glands and of 8 lobes that occurs in the later version. Not only in the species, as described, are the glands twice as many as usual: the apparent quinary symmetry of the cyathium itself is denied. The letter of the document reveals *E. Synadenium* either as not less extraordinary a form than *E. pedilanthoides,* or a downright pathologic case.

Before investigating the species, it is necessary to establish its correct name according to the present Rules of botanical nomenclature. In his original publication, Ridley practically admitted that his name *E. Synadenium* (which clearly referred to the genus Synadenium) was homonymous with *E. Synadenia* Baillon. At that time, it was still customary among many European botanists to regard such a homonym as valid, if the earlier name, as in this case, was transferred to another genus. By the recent change in the Rules of botanical nomenclature, however, all later homonyms are invalid. Ridley's name can therefore stand only if we regard it as distinct from *E. Synadenia.* This raises the nice question of what differences may be admitted as constituting distinct names, and conversely. The Rules are decidedly vague on this matter, but in view of Ridley's tacit admission, and of the fact that the two names can legitimately be regarded as of different gender only, it appears right to regard them as identical. A new name is therefore needed, and is given below. It may also be mentioned that Boissier mistranscribed Baillon's name as *E. Synadenium* in the synonymy of *Synadenium arborescens* (D.C. XV: 1269, 1866); but by Art. 40 of the Rules such a synonym has no validity as a published name. The loss of the name *Synadenium* for the present species is not to be regretted, as the "glands" are far from connate.

The writer stands under deep obligation to Mr. Holttum who kindly consented to send on loan the material preserved in the herbarium of the Botanic Gardens of Singapore (No. 1190, VII. 13. 1916, leg. Mohammed Haniff; s.n., III. 6. 1926, leg. E. Seimund) and arranged for the transmission of live rooted cuttings and detached cyathia in fluid. The description to follow, unfortunately, is still short of the data from the ♀ cyathium, although a nearly ripe capsule is recorded.

E. Ridleyi nom. nov., descr. emend.—Leaves alternate, crowded at the tip of carnose slender twigs, glabrous, up to 21 cm. long, 7 cm. broad; blade oblanceolate to subelliptic, very entire, occasionally sublobate (1 lobule seen on 1 leaf), more or less deeply notched at the rounded apex, when dried thickened at the margin and smooth or obscurely and irregularly veined beneath, mostly tapering from the upper third or fourth to a distinct roundish subwinged petiole up to 3½ cm. long; midrib conspicuous beneath canaliculate above ending in a short stiff deciduous mucro; leaf-stipules 2, minute carnose, irregularly conic, grooved, persisting or not at the slightly upraised leaf-scars. Inflorescence strictly axillary of 1–2 (and more?) variously arranged cymes, mostly bistipulate at base, up to 2.5 cm. long; cyathia unisexual, clustering, on monocephalous short peduncles about 2 mm. long, or single on a peduncle 6 mm. long extended beyond a pair of minute bracts into a pedicel 8 mm. long, or in pairs on a common peduncle 5 mm. long and individual pedicels up to 7 mm. long. Cyme-bracts opposite, free or subconnate at base, carnosule, subquadrangular to broad ovate, mostly apiculate, to 3 mm. long. Cyathium (only ♂ seen in fluid and dissected) up to 11 mm. wide with a very shallow involucre and manifestly deflected (at ca. 45°) nectaria [glands], these about as broad as the involucre itself is deep; cyathium-bracts 2–3 spirally ascending or subopposite, clasping, occasionally exceeding the cyathium, carnose, broad ovate to round triangular, apiculate or entire at apex, keeled or rounded on back, up to 4 mm. long and broad; nectaria [glands] 4–5, contiguous, quadrangular to elliptic, rugulose pitted, shallowly and irregularly crenate at margin, 5–6 mm. long, 3–3½ mm. wide; lobes 4–5 elliptic, denticulate 3 mm. long, 2 mm. wide; ♂ flowers [stamens] numerous in (4–) 5 fascicles; staminodes very numerous, carnosule, spatulate, laciniate cleft, to 4 mm. long. Capsule glabrous, smooth or rugulose, 1.3 cm. wide, 8 mm. long, exserted on a thin stipe 8 mm. long; cocci 3, often unequally developed, discrete, the rounded keel becoming more or less thin-acute towards the recurved end; calyculus irregularly 3–5 lobulate, scarcely 3 mm. broad; styles 3, cleft to base, subulate, entire, spreading. Seed not seen.(1)

(1) *E. Ridleyi* nom. nov., descr. emend. (*E. Synadenium* Ridl., nec Boiss. (sphalm. Baill.)) Frutex diffusus 2–8 ped. altus, ramulis succulentioribus ultimis crassitie calami scriptorii. Foliis alternis subverticillatis carnosis glabris, ad 21 cm. longis, 7 cm. latis, apice rotundatis, oblanceolatis subellipticisve, rarissime sublobatis, emarginatis; petiolo ad 3½ cm. longo; stipulis petiolaribus binis subconicis rimosis minutis deciduis vel ad folii cicatricem subelatiorem persistentibus. Cymis axillaribus ad 2.5 cm. altis; cyathiis monosexualibus pedunculatis pedicellatisve ad 11 mm. latis; nectariis 4–5 contiguis foveolatis, ad 45° deflexis, involucri ambitum aequantibus; lobis 4–5 ellipticis, denticulatis, 3 mm. longis, 2 mm. latis; staminibus multis (4–) 5-fasciculatis; staminodiis plurimis; capsula exserta stipitata ad 1.3 cm. lata; coccis 3, discretis recurvis; calyculo 3–5 lobulato; stylis 3, partitis, subulatis intergris. Semina desiderantur.

Loc.: Penang Hill, near the Waterfall: Selangor, Langat (Ridley). Pulau Rumbia (specimen). An indication that the range might tend to become more circumscribed is apparently given in a note from Mr. Holttum (*in litt.* Aug. 1935) mentioning that the plant was not found at an easy accessible former habitat at Penang, although it was still being reported from the south of Penang Island.

The habit is described as follows by Mr. Holttum (*in litt.*, Febr. 1936) "I recently saw an old plant of the species in Penang; it was scrambling over a large rock in half shade and had reached a considerable length, though the stem was still quite slender". This peculiar habit is observed in several Mexican and Tropical American species.

Plainly interpreted *E. Ridleyi* is a form less remarkable in itself than Ridley's diagnosis suggests. Truly remarkable, however, is this species in floristic and in phytogeography.

The understanding of *Euphorbia* at this hour is still fundamentally what it was in the days of Linnæus. In the opinion of the writer the "genus" is a threadbare net of diverse evolutive phyla artificially connected by a common type of inflorescence (cyathium) which the Linnaean understanding consciously or unconsciously treats as a flower. The sections which attempt to present the countless species of *Euphorbia* as a rational whole use in the majority of the cases imperfect concepts, and uncritically accepted are an hindrance rather than a help to study. The fact that N. E. Brown who enjoyed unsurpassed facilities for studying the Linnæan genus disregards sections altogether in his classic works may be invoked to absolve the writer from the duty of proving his statements at this hour. It is plainly not advisable to abound in citations of modern works which, *e.g.*, introduce sect. *Tenellæ* in the Gangetic peninsula in the wake of *E. dracuncoloides*, or very nearly propose a new section on the strength of the digitate nectaria of *E. clavidigitata* from Burma. For the purpose at hand the sections of Hooker (Fl. Brit. Ind. V: 245–246, 1890) are as good as any.

Hooker accepts (o.c., l.c.):

Sect. I.—*Anisophyllum* with subss. *Elegantes, Hypericifoliæ, Chamæsyceæ.*

Sect. II.—*Euphorbium* with subss. *Tirucalli, Dicanthium, Rhizanthium.*

Sect. III.—*Tithymalus* with subss. *Galarhæus, Esula.*

The principles of a sound classification of the Linnæan genus were perfectly understood by Roeper (En. Euph., 1824), who emphasized the faculty peculiarly inherent to *Euphorbia* to suppress and to shorten axes (o.c., 28 *et passim*). It may be that

the Enumeratio Euphorbiarum is a juvenile work weak in taxonomic understanding : the fact stands that Roeper had a sounder grasp of the *nature* of *Euphorbia* than Boissier and other well-known botanists, and one may regret that Roeper failed to present the monograph of the genus on which he was known to work (Ch. des Moulins in notes to *E. Milii*, Bull. Hist. Nat. Soc. Linn. Bordeaux I : 27, 1826).

Judged as *natural* groups in the light of Roeper's basic premises *Anisophyllum* and *Tithymalus* have a value that beyond comparison exceeds that of *Euphorbium*. In *Anisophyllum* the main axis aborts immediately above the first pair of leaves, and, therefore, may be technically described as indefinite. The species of the section are all harmonious in the sense of evolution : their development can take place only from buds in the aborted main axis, which simple fact accounts for their axial arrangement, habit and interpetiolar stipules. In *Tithymalus* the main axis develops and is definite, to say ends with a terminal cyathium. The sections lacks stipules and has fundamentally alternate leaves at the axes that are not immediately flower-bearing. Any one who has worked with *Euphorbia* recognizes *Anisophyllum* and *Tithymalus* at sight, for, it has been noticed, they are *natural* groups. The subsections need not be discussed at present.

Euphorbium covers *Tirucalli, Diacanthium, Rhizantium*. The last may be disregarded here. It probably includes regressive and depauperate forms, or highly specialized species from different evolutive phyla and, appearances to the contrary, has never been fully explored. *Tirucalli* has axes that are definite precisely as are those of *Tithymalus*. The main stem evolves freely and the floriferous axes end with a cyathium surrounded by a pseudo-umbel of more or less long-pedunculate and long-pedicelled cyathia. The fact that some species of the *Tirucalli* of common understanding have stipulate leaves may not be discussed even briefly at this hour : suffice it to establish that *Tithymalus* and *Tirucalli*, naturally interpreted, stand on the same phylogenetic and systematic line. *Diacanthium* abhors *Tirucalli*. Its axes are indefinite, not carrying true terminal cymes (pseudo-umbels). Its prickles are spinescent aborted axes prescisely matching those observed in *Rosaceæ, Rhamnaceæ, Rutaceæ*, etc., and not relicts from a ternate foliar verticil or from lobes and auricles at the base of the blade. In brief : *Tirucalli* and *Diacanthium* are "classified" under one section for no better reason than their being succulent.(1)

Concluding : *E. Ridleyi* can not be a *Tithymalus, a Diacanthium* or a *Tirucalli*, and still less an *Euphorbium* which *sectio ineptissima* is wholly an horticultural figment. *E. Ridleyi*

(1) The issues that here must be briefly outlined in order to define the position of *E. Ridleyi* will be treated in detail in a coming publication.

naturally falls in with certain species of sect. *Goniostema*, a section which so far has not been known to exist in Asia.

The *Goniostema* species with which *E. Ridleyi* has affinity are those that Boissier describes (D. C. Prodr. XV 2 : 77, 1862) as having *stipulas indivisas* (typ. *E. pyrifolia*). The species which Boissier lists *stipulis verticalibus cristæformibus* (o.c., 78; typ. *E. leuconeura*) have nothing to do with the true *Goniostema*, Their affinities wholly lie in the direction of the group represented by the so-called *E. splendens*(1). Denis correctly shifts them (Euph. II. Austr. Afr., 72, 1921) there, unfortunately, however, offsetting this pertinent change with the inclusion of *E. orthoclada* under *Goniostema*. *E. orthoclada* has definite axes and pseudoumbels, and belongs with *Tithymalus*.

Compared with the species of *Euphorbia* of the Malaysian, Indochinese and Australasian domain *E. Ridleyi* is found naturally to agree only with *E. epiphylloides*, an endemic of the Andaman Islands (v.v.) which has no place with the *Tirucalli* species among which it has so far been listed. The peculiar flattened stems of *E. epiphylloides* do not alter the basic characters of inflorescence, leaf-stipule and habit, *sensu lato*, that make of it an outspoken *Goniostema*. *E. plumerioides* with range from the Philippines to Java belongs to *Tithymalus*. Two species respectively from the Straits of Torres and from Queensland and New Zealand, *E. corynoclada* and *E. glauca* abhor *E. Ridleyi*. The former, as Manson Bailey appears to claim correctly (Queensl. Fl., V : 1400, 1902) is close to *E. aphylla* which is a Canarian endemic of the *Tirucalli* description. The latter is a strand-species which is similar to the *Euphorbia* species from the Macaronesian domain included by Boissier in *Tithymalus* subs. *Pachycladæ*.

There is a bare possibility that *E. Ridleyi* is allied with *E. Cleopatra* (n.v.), from New Caledonia. This island, and its archipelago, are a domain of extraordinary interest for the student of *Euphorbiaceæ*. Regardless, however, of a possible connection with *E. Cleopatra* the affinities of *E. Ridleyi* are in the direction of species from Madagascar and the groups of islands in the Indian Ocean. Thus *E. Ridleyi* and *E. epiphylloides* stand at the eastern, *E. pyrifolia* at the western pillar of a collapsed bridge : they brood over a continent that has been engulfed by the Indian Ocean. In the truest sense of the word they are relicts, which is it proper to designate as Gondwanic relicts.

Gondwanaland up to the beginning of Tertiary times connected Africa with Malaysia and Australia, and sound evidence has been unearthed to the effect that at the same time or

(1) Bojer's binomial, *ex* Hooker, owes its success to the circulation of pl. 2902, Bot. Mag. 1829, but loses precedence to *E. Milii* Ch. d. Moul., Bull. Hist. Nat. Soc. Linn. Bordeaux, I : 27–30, *cum ic.* 1 *e.* 1826. Des Moulins' binomial is far from being the *nomen nudum* which it is generally supposed to be.

shortly before Africa was connected with America (1). Under the standpoint of palaeogeography a relationship between the life-forms of Madagascar and Malaysia, at least as far east as the Wallace's Line, is not only posible but probable. Botanically the evidence in favour of such connection is quite strong. Only to mention one family, *Euphorbiaceæ*, have identic genera in Tropical America and in Africa (cfr. Lanjouw, Euph. Surin., 79–84, 1931). The connection established between the Malagasy and the Malaysian domain by the species of sect. *Goniostema* has just been recorded. Merrill pointedly remarks (Ess. Geob., 247, 1936) that the flora of Polynesia is essentially Malaysian. The same phyla have "tapered" to closely allied genera in distant continents (cfr. *Richeria* and *Richeriella; Baccaurea* and *Aporosella*). The phylum of *Euphorbiaceæ* is not holartic: it harks back, it seems, to forms the beginning of which must be sought at the Permo-Carboniferous glaciation, and its axis of migration is roughly parallel to the equator of to-day in a west-to-east direction. The migration of the holartic phyla is roughly perpendicular to the equator, and confusion need not be made between the two main streams of diffusion of plant-life.

The persistency of isolated species at extreme points of a geologic plant-domain is not surprising. Van Steenis remarks (Bull. Jard. Bot. Buitenz. XIII: 393, 1935) that Malaysia from the Cretaceous on has practically always been wholly within the tropical zone. In contrast to the widespread assumption life does not *naturally* exhibit an aptitude to change. It reacts against the forces in the ambient, and ultimately dies or migrates or is transformed when the pressure of the ambient becomes too strong. It would seem, lastly, that the more a plant-group has been capable of changing in the past the more it is apt to change in the future. *E. Ridleyi* is an archetype lingering in a favoured area, which is matched by *E. epiphylloides* and, if the writer be correct, by certain genera of Malaysian ferns. It is curious to notice that an analogy appears to exist between the rhythm of plant-life at one hand and the laws of motion at the other.

(1) The bibliography on this subject vastly exceeds the limit of space allowed to these cursory notes. The reader may consult Th. ARLDT, Handbuch der Paläogeographie, 2 vols., 1919–1922; J. W. GREGORY, The Rift Valleys and the Geology of South Africa, 1921; A. P. COLEMAN, Ice Ages Recent and Ancient, 1926; A. DE TOIT, Geology of South Africa, 1926; (T. H. GOODSPEED, edit.) Essays in Geobotany in honor of W. A. SETCHELL, 1936. A masterful study on polar shifts is D. BLACK'S, Palaeogeography and Polar Shift, Bull. Geol. Soc. China, X, 1931.

PALMÆ MALESICÆ.

VI.—Notes on Some Dæmonorops of the Section CYMBOSPATHÆ.

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1. Summary and Introduction.
2. Systematic Difficulties Inherent in the Species of the Section.
3. Good and Ample Collections are Needed.
4. Specimens should be Adequately Numbered.
5. Data to be Noted on the Field-labels.
6. Distribution of Sex in the Individual Plant and Spadix.
7. Sex of the Clump.
8. Is Dæmonorops Parthenogenetic?
9. Systematic Notes.

1.—Summary and Introduction.

This paper embodies some results obtained in the course of my study of rattans belonging to the genus *Dæmonorops* of the section CYMBOSPATHÆ. My inquiry is based mainly on the herbarium material, but I have also had opportunities of studying some few species in the field and the results of these also are embodied herein. Both these investigations have strengthened my previous conviction that much of the vagueness hitherto observable in the specific circumscription of many species is due to the inadequacy of the herbarium material coupled with its faulty numbering. These two aspects of the subject I have already touched on in previous papers (cf. Gard. Bull. S.S. VIII, 1935, pp. 241–261, and 339–367). But so important is this matter to the systematist that I make no apology for reverting to it here. If the systematist is to clear up the status of the doubtful species and to devise a simpler means of classifying rattans, a large series of herbarium specimens, prepared according to the needs of the systematist, becomes an indespensible preliminary, and part of this preliminary is the issuing of detailed instructions to plant collectors.

The opinion that normally the genus *Dæmonorops* is monœcious with unisexual spadices, is herein shown to be fallacious. All the specimens so far seen go to support Beccari's contention that the genus is diœcious, the male-like acolyte of the female being a neuter flower. In some species, however, of the section CYMBOSPATHÆ the male plant seems to play no part in the development of the fruit, the female plant itself being apparently parthenogenetic. Further observations are needed to verify this apparent parthogenesis in *Dæmonorops*.

My inquiry into the systematics of the Malayan species of *Dæmonorops* of the section herein treated was much simplified by obtaining on loan authentic specimens of Griffith's species from the herbarium of the Royal Botanic Gardens, Calcutta, and some critical specimens from the herbarium of the Botanical Gardens, Buitenzorg. It is my pleasant duty here to record my indebtedness to the respective Directors, of the two institutions named, for their kindness in allowing the loan. The results obtained may be summarised as follows:—

(1) **New Species:** (*a*) *D. angustispathus* and *D. Curtisii* from the Malay Peninsula; and (*b*) *D. javanicus* from Java.

(2) **New Records:** (*a*) for the Malay Peninsula: *D. melanochætes;* (*b*) for Borneo: *D. hygrophilus* (doubtful) and (*c*) for Sumatra: *D. hygrophilus, D. Lewisianus* and *D. pseudosepal.*

(3) **New Interpretations:** *D. intermedius* (Griff.) Mart., *D. Lewisianus* (Griff.) Mart., *D. malaccensis* Mart., and *D. monticolus* (Griff.) Mart., all of which are indigenous and endemic in the Malay Peninsula. These interpretations have been based on the authentic specimens, (when available in the Calcutta herbarium), as well as on the description and the drawings published by Griffith.

(4) **New Synonyms** (Species newly reduced to the synonymy): *D. aciculatus* Ridl., *D. bakauensis* Becc., *D. carcharodon* Ridl., *D. congestus* Ridl., *D. imbellis* Becc., *D. intermedius* var. *nudipes* Becc., *D. malaccensis* Mart., *D. microthamnus* Becc., *D. monticolus* var. *pinangianus* Becc., *D. petiolaris* Mart, and *D. Schmidtianus* Becc. The possibility of *D. fissus* var. *cinnamomeus* Becc. being identical with *D. hygrophilus* is indicated.

2.—Systematic Difficulties Inherent in the Species of the Section.

Anyone who has attempted to study the rattans of the genus *Dæmonorops,* belonging to the section CYMBOSPATHÆ, will at once realise that, although the species can be classified readily into definite groups, to make a clear cut delimitation between the different members constituting each group, is a different, and rather a difficult, matter. Beccari, in spite of his prolonged studies, was unable to overcome this difficulty, and therefore he ventured a suggestion, according to which each one of the groups would be regarded as a collective species (synspecies), the different individual members of the groups being treated as so many sub-species. (Calc. Ann. XII, 1911, p. 28, footnote).

No doubt a chief reason why the separation of the species is a difficult task is the very close relationship existing between them; in many cases no conspicuous and easily describable diagnostic characteristics distinguish one group from another.

But perhaps a reason of no less importance is our ignorance of the full amount of variation in each species: for the species of the section CYMBOSPATHÆ vary greatly in regard to the size of the leaflets, spathes, and spadices; and also to a certain extent in regard to the nature and arrangement of bristles or spines on the spathes and leaf-sheaths in different parts of the same plant, or else at different ages, or under different ecologic conditions. Moreover, the material available in the several herbaria of the world is often inadequate as a source from which to draw reliable distinctions between different but closely related species. While such distinctions are, or at least seem, quite obvious in the field, they cannot be verified in the herbarium on account of the poorness of the material there available.

3.—Good and Ample Collections are Needed.

In order to obviate in their studies complications arising from difficulties in regard to species, systematists have been content hitherto with the expedient of classifying species geographically, and so, of dividing the entire *Dæmonorops* area into several geographic sub-units. Under this expedient they describe as new every find that does not correspond with any species previously described in relation to its respective geographical sub-region or sub-unit. Only when it is quite obvious that a specimen belongs unmistakably to a quite distinct species already defined as inhabiting another sub-region or sub-unit will it be admitted as an old species into the region where it is newly found. While this prodecure had the advantage of throwing some light on the rattan floras of the regions studied, its legitimacy as a form of classification can scarcely be defended, consequently it is high time that a pause should be agreed upon to enable the conception of species to be de-geographized. But to do this thoroughly would entail the critical examination of a large series of material of the "synspecies" from the different regions.

No doubt the first disclosure would be the paucity and insufficiency of the material represented in the herbaria of the world. Next, it would necessitate collectors being asked to contribute towards discovering the true species by striving to show in their collections the extreme variations that occur in the adult forms of the rattans. They should be encouraged to give one number to each individual plant and to include in the principal sets two complete specimens showing the extremes of variability of the individual. If the collectors could be induced to make complete specimens, as recommended in my previous papers (Gard. Bull. S.S. VIII, 1935, p. 242, and 342), much of the present confusion would vanish like a guilty thing or like the furrow cut by a ship's keel in the sea.

4.—Specimens should be Adequately Numbered.

In this connection one cannot emphasize too strongly the importance of numbering rattan specimens carefully in the field. Ridley tried to study the *Dæmonorops* species from the Malay Peninsula without numbering the specimens in the field, and obtained but very poor results. Ridley alludes to his studies in the field in the following remarks made in his *Flora V*, 1925, p. 34 :—

> "These plants vary much in the size of leaflets, spathe and spadix, bristleness and arrangement of spines on the sheaths in different parts of the same plant. Many species have been based on totally inadequate herbarium material. I have seen many of the species wild, often in abundance, and cultivated many of them. Beccari's volume *Ann. Bot. Gard. Calc. XII*, with large photographs of the herbarium specimens is invaluable, though I am by no means agreed as to some of his determinations. Specimens are so bulky and spiny that collectors are apt to bring home mere scraps of the plant which are utterly unreliable. They can only be properly studied in the forests".

A close examination of Ridley's determination of the species of *Dæmonorops* of the Malay Peninsula (cf. my paper in Gard. Bull. S.S. VIII, 1935, pp. 339, 367, and *vide infra*) reveals the fact that the specimens, owing to Ridley's not having numbered them in the field, were often so mixed that Ridley himself could not disentangle them correctly. Naturally, therefore, when coordinating his field observations in the herbarium, Ridley came to several erroneous or misleading conclusions; and but for the specimens collected and numbered according to the system introduced into Malaya by Ridley's successor, Mr. I. H. Burkill, as the Director of Botanic Gardens, Singapore, Ridley's errors in classification and determinations of the *Dæmonorops* species would have remained beyond correction, or anyhow extremely difficult to correct.

This miscarriage of Ridley's long and painstaking studies in the field, coupled with his systematic investigations in the herbarium, should prove to botanical institutions how imperative it is to impress upon the departmental plant-collectors, or upon the collectors of the expeditions supported by them, the real necessity not only for making their rattan collections as complete as possible as directed in my previous notes (Gard. Bull. VIII, 1935 pp. 242 and 342), but also for numbering them adequately in such a manner as to prevent the component parts of one from getting irretrievably mixed with the component parts of another. I am firmly convinced that good specimens, if properly labelled, would also render the systematist less dependent on field notes for their accurate determination.

5.—Data to be Noted in the Field-Labels.

It is evident, from a reading of the several floristic works, that very little information is available about the actual habit of many rattans. The data recorded in the field-notes is likewise so meagre that it often takes one not a step forward. After a thorough study of all the information presently available in the published works, and particularly those carefully noted on the herbarium labels, our knowledge of the habit of certain rattans is still obscure; thus it is difficult to say whether they are solitary or tufted, whether they are long climbing, like *Calamus scipionum,* attaining a length of over 150 feet, or whether they are short, like *Dæmonorops grandis,* or erect or subscandent, like *D. Lewisianus.* From the description available, for instance, one would not imagine that the stems of *D. calicarpus* are very short, being not more than 1–3 feet high and scarcely visible to a casual observer, hidden as they are by long radical leaves, which grow all round the bush and attain a length often many times greater than the actual stem and its leaves together. But if the specimen sent in by the collector, besides being collected according to the necessities of the systematics explained herein, were accompanied by field notes or photographs indicating the habit of the species chosen, then the systematist could get a better conception of the species and might eventually succeed in devising a classification that would render less difficult the circumscription of many a puzzling species.

In the case of tufted rattans, specimens of the radical leaves are not absolutely necessary, the adult leaves are the most important. But if the radical leaves are taken and numbered separately, so as to prevent them being confused with the adult ones, but at the same time to show their relation to the latter, they might help to bring out the characteristics of the species more clearly.

6.—Distribution of Sex in the Individual Plant and Spadix.

There still exists considerable confusion regarding the distribution of sex in the species. In the *Materials II* (*1907*) *pp. 173 and 174,* Ridley definitely states that the spadices of *D. angustifolius* are bisexual, a statement he repeats later in *Flora V* (*1925*) *p. 36.* In the latter work Ridley notes that he has not seen any specimens of *D. Scortechini* and *D. sepal;* yet in his Key to the species (*p. 35*), he lists these two species with *D. angustifolius* as having bisexual spadices. This is surprising, seeing that Beccari, the author of the two namings, has definitely stated the opposite regarding the sexes of the spadices in the genus *Dæmonorops;* nor has any one else described the species at length; it must therefore be regarded as gratuitous that Ridley should re-define the sex without giving any support-

ing observation. Beccari's remarks on the question seem worth quoting here :

> "As in the *Calami*, the spadices of *Dæmonorops* are always dioecious, though one may sometimes happen to meet with a male spadix with a hermaphrodite flower here and there. It is possible that the female spadices of some CYMBOSPATHAE are cleistogamous—at least, I suppose they may be having observed that certain still closed spadices of *D. fissus* contained ovaries in process of development, which had every appearance of having been fecundated. The closure may however have been more apparent than real, and thus an insect may have been able to penetrate into the interior through the half closed spathes." (Calc. Ann. 1911, p. 2.).

Regarding Ridley's views on the subject, Beccari comments as follows :—

> "Mr. H. N. Ridley (*Mat. Fl. Malay. Pen. II, 1907 p. 171*) says that the spadices of the *Dæmonorops* are usually unisexual, and that male and female inflorescences are on the same stem—a fact which I have never observed. The same author (*l. c. p. 172*) adds that both sexes occur on the same plant : furthermore, he describes the spadix of *D. angustifolius* as having a 'bisexual spadix, male and female flowers on the same spadix in pairs.' Apparently Mr. Ridley has considered as a fertile male flower the neutral or sterile flower which accompanies every female flower on the female spadix in all the species of Dæmonorops I have examined."

After examining several *Dæmonorops* of the section CYMBOSPATHAE cultivated in the Singapore and Buitenzorg Gardens, I can testify to the authenticity of Beccari's observations on the distribution of sexes in the individual spadices and plants of the genus *Dæmonorops*, even of *D. angustifolius*, in which species Ridley appears to be quite positive of the bisexuality of the spadices. No doubt Ridley's collections in the Singapore Herbarium often show male and female spadices on the same sheet, or on different sheets, but bearing the same number, as if the specimens were collected from the same plant or clump. But still there are strong objections to basing conclusions upon such an evidence. Ridley numbered his specimens, not in the field, but in the herbarium and after study; and there are many instances to show that he did not hesitate to give one and the same number to specimens that, although obviously not derived from the same clump, appeared to him to represent the same species (cf. my remarks on *D. angustifolius* and *D. grandis*). As to his observations in the field, besides mistaking a neutral flower for a male in *D. angustifolius*, it has to be noted that he has sometimes taken a young female spadix for a male (*vide*

my remarks on *D. setigerus* in Gard. Bull. S.S. VIII, 1935 p. 363); and from such erroneous observations, he has concluded that the genus *Dæmonorops* is normally monoecious, male and female flowers being found in different spadices (*Materials, II 1907, pp. 171 and 172*), and in his Flora (*I', 1925, p. 34*) Ridley has persisted in his opinion despite Beccari's adverse criticism.

It is true that, as pointed out by Beccari (op. cit. XI, 1908, p. 18; XII, 1911, p. 2), a rattan female spadix might occasionally bear, at its apex, a few spikelets composed entirely of male flowers (*e.g., Calamus perakensis,* not observed in *Dæmonorops*). or that the hermaphrodite flowers might be found here and there on a male spadix. But this is not the usual phenomenon either in *Dæmonorops* or in *Calamus;* therefore one cannot rightly regard it as establishing that either of these genera is normally monoecious with unisexual spadices.

7.—Sex of the Clump.

Though observations so far made show clearly that *Dæmonorops* plants bear male and female spadices in different individuals, it is not yet very clear whether the individual stems in a clump are all alike in sex. I have seen several live clumps of *Dæmonorops,* and, as far as it could be ascertained, the clumps were always of one sex; that is, if one individual was found to be male, then all the other individuals in the same clump were noticed to bear male spadices; the same was true for the female sex. But in one single clump of *D. fissus,* growing in the Singapore Botanic Gardens, I found male and female plants (male in the majority) in the same clump. Now the question arises whether this clump with male and female individuals, is a result of one or two seedlings being planted in the place. Our records do not throw any light on the matter; but further observations in the forests might enable one to say definitely whether a male clump will occasionally produce female individuals, or vice-versa.

8.—Is Dæmonorops Parthenogenetic?

Though *Dæmonorops* species are normally dioecious, it does not follow that they are dependent invariably on the male plants for the production of the fruit. In some species of *Dæmonorops* of the section CYMBOSPATHÆ the female flowers attain their full maturity and develop into fruits when the spadix is still enclosed in the spathes. Hardly any pollinating agent can have access to the flowers shut within the spathes, and excepting the ants, which seem to have a special predilection to all kinds of rattans, and which possibly are the only visitors that might gain admission to the flowers through the enclosing spathes, one rarely, if ever, sees any insect or bird visiting the female spadices. For carrying pollen for long distances, however, the ant is an

almost negligible agent. Unless we assume, then, that the fruits develop parthogenetically—a fact that would mean the male plants are useless,—it is difficult to explain the development of good fruits in such species as *D. angustifolius, D. grandis,* and *D. fissus* (species observed by me) when there exists no male plant of any *Dæmonorops* species within a radius of about 300 feet, or, may be, considerably more.

In this connection it is to be observed that the spadices in some cases show two kinds of female flowers, one with ovaries fully expanded before the anthesis of the inflorescence, and the other not so expanded. Normally only the expanded flowers develop into fruit. But may it not be that the development of the other flowers are dependent upon their receiving pollen from male plants? This explanation, which might account for the existence of the male plants in *Dæmonorops* as well as for the two kinds of female flowers on a spadix, is suggested here with a view to focussing attention on this problem and to encourage field observations.

On the other hand it is possible that, during the early stages of the development of the spadix, the smaller flowers that later fail to develop, are merely those that lag behind in the competition between the flowers for food, and for space in the spadix.

It may be observed that in the Singapore Botanical Gardens there is a female clump of *D. Kurzianus* Becc. *ex descriptione* which always produces female individuals, and, though fruits develop to a large adult size, seeds within the scale-covering remain always abortive. The plant is a native of the Andamans, and, as this group of islands have a somewhat different climate than that of the Singapore Garden, it is possible that this lack of development of good-seeded fruits is not attributable to the absence of male plants of the species in the Singapore Gardens: A species that in its native habitat is parthenogenetic, may refuse to produce, in a different climate, any seeds even when pollinated.

All this will show how sparse is our knowledge about certain biological problems concerning the sex in *Dæmonorops* and will indicate the necessity of utilizing every available opportunity of making field observations on the subject.

9.—Systematic Notes.

I. **Dæmonorops angustifolius** (Griff.) Mart., Hist. Nat. Palm. III (1850) 329; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 464, in Rec. Bot. Surv. Ind. II (1902) 219, et in Calc. Ann. XII (1911) 69 t. 18; Ridl. in Journ. Roy. Asiat. Soc. Straits Br. 33 (1900) 175 et 57 (1911) 110, Mat. Fl. Malay Pen. II (1907) 174, et Fl. Mal. Pen. V (1925) 36, omnino pro parte.

Calamus angustifolius Griff. in Calc. Journ. Nat. Hist. (1844) 89, et Palms Brit. Ind. (1850) 95 tt. 213 A and B (*Type locality* = Malacca).

D. carcharodon Ridl., Mat. Fl. Mal. Pen. II (1907) 178 et. Fl. Mal. Pen. V (1925) 40.

D. hygrophilus Mart. *sensu* Ridl. in Journ. Roy. Asiat. Soc. Str. Br. 33 (1900) 175, Mat. Fl. Mal. Pen. II (1907) 178, et Fl. Mal. Pen. V (1925) 40, pro parte. **syn. nov.**

Malay Peninsula: **Pahang,** Sungei Bera near Tasek Bera (Henderson, 24,620). **Perak,** Temango (Ridley, 14,719, female). **Malacca,** loc. incert. (Griffith, [vern. name *Rotan Ghitah*] in Calc. Herb. Holotype). **Selangor,** Batang, Berjuntai (Ridley, 7880); Batu Tiga (Ridley 11,983*). **Johore,** Mawai Jemaluang Road (Corner, 29,749, vern. name *Rotan Manau*); Sungei Semangat in Muar (Fox, 11,299); Danan, along Sungei Sedili (Corner, on 27–III–32, vern. name *Rotan Tawar*). **Singapore,** Bukit Panjang (Ridley in 1907; and n. 13,302); Choa Chu Kang (Ridley, in 1896*); Bukit Timah (Ridley in 1900); Bukit Mandai (Ridley in 1900); Selitar (Ridley, 6279*); Chan Chu Kang (Ridley, 4622, vern. name: *Rotan Sepat*).

Griffith's type specimens in the Calcutta herbarium consist of the terminal portion of a leaf and the portion of a male spadix, figured in Griffith's plate 213-A, as well as of the petiole with its sheath figured in the plate 213-B. The unopened inflorescence and the detached spathes figured in the second plate are not represented in the specimen; judging by the description Martius gives of the species they are to be found perhaps in the Munich herbarium. Certainly they are not in Kew. A comparison of the authentic material in the Calcutta herbarium, and of Griffith's plates, with the Peninsular material from the Singapore herbarium leads me to concur fully with Beccari's interpretation of *D. angustifolius*. The prickles on the leaf-sheath are rather short in the authentic specimen, but this is no doubt due to the young age of the specimen.

Ridley was much confused over this species. Apparently he took as equivalent all the specimens bearing his field number 5123, though he had given this number to specimens collected from more than one clump, growing in the Singapore Botanical Gardens, and belonging to more than one species (*e.g. D. angustifolius*, and *D. grandis*). Further, from some insufficient data he came to the erroneous conclusion that spadices in *D. angustifolius* are always bisexual. It is not surprising therefore, that, with such a mixed herbarium material to go by and with a mistaken conception concerning the sex of the spadices of the species, Ridley not only erected the new species *D. carcharodon* to include the specimens that did not fit in with

* Syntypes of *D. carcharodon* Ridl.

his acceptation of *D. angustifolius* (Materials II, 1907, p. 178), but later (Flora V, 1925, p. 40) dismissed as erroneous Beccari's placing of the new species among the synonyms of *D. angustifolius* (Calc. Ann. XII, 1911, p. 69).

Ridley's specimen no. 5123 that Beccari quoted as having been collected from a wild plant at "Lawas" in Singapore, is derived from a plant cultivated in the Botanic Gardens, Singapore, the word "Lawas" being a result of misreading of the word Lawns, the garden being divided into a number of sections called lawns. Ridley's no. 11,983 from Selangor—a syntype of *D. carcharodon*—is mounted on two sheets and consists of a mixture of three species, as follows: leaflets of *Calamus scipionum*; fruits and fruiting spadix of *D. grandis;* and a leaf-sheath, a portion of leaf-lamina and an unopened, male spadix of *D. angustifolius*.

The Peninsular material varies a good deal regarding the armature of the petiole, leaf-sheath, the leaf-rachis, and second spathe, so that it might be possible to reduce *D. trichrous* Miq. as a synonym of this.

II. Dæmonorops angustispathus Furtado **spec. nov.**

D. grandis Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 177 et Fl. Mal. Pen. V (1925) 38 quoad specimen Ridleyanum infra citatum. *Syn. nov.*

D. Lewisianus Mart., Hist. Nat. Palm. III (1850) 327; Becc. in Calc. Ann. XII (1911) 87 t. 30: Omnino quoad specimen Gaudichaudianum in herb. Parisiensi. **Syn. nov.**

A *D. grandi,* cui affinis est, inflorescentiis spathisque angustioribus, ante anthesin lineario-lanceolatis; spathæ extimæ rostro multo longiore quam corpore; frondium segmentis angustioribus hæc species facile distingui potest.

Caudex, vagina. petiolusque ignoti. *Lamina* frondium, secundum partem visam, magna, rhacheos dorso inermis, vel aculeis solitariis tenuibus brevibus distantibus armata. *Cirrhum* non visum. *Segmenta* plura, subequidistantia, 4–5 cm inter se remota, lineario-lanceolata vel ensiformia, maxima latitudine ad medium vel infra sita, 45 cm longa, 15–18 mm lata, apicem versus valde angustata, acuminatissima; supra secus tres costas setulosa, vel interdum in costa media inermia vel apicem ejusdem versus tantum armata; subtus ad costam mediam tantum setulis approximatis prædita. *Inflorescentia fœminea* sessilis, cum rostro lineario-lanceolato 25 cm. superante 45 cm. longa. *Spathæ* persistentes: *extimæ* corpus 18–20 cm longum, bicarinatum, (tractu intercarinali ad 1 cm. usque lato), deciduo fusco-furfuraceum, aculeis paucis, distantibus, solitariis, interdum confluentibus, laminaribus vel subcriniformibus, nigritellis, ad 2.5 cm. longis armatum; rostrum clausum permanens,

eodemmodo armatum, 25 cm. superans, 5 mm. latum: *secunda* (spatha) et tertia paulo latiores aculeis minoribus, solitariis, secus carinas obsoletas apicem versus tantum parcissime armatæ: internæ inermes. *Rami* spadicum primarii 4, porrecti, ad 6 cm. longi, alternati, 5–6 cm. inter se dissiti; *secundarii* ad 2.5 cm. usque longi, axi rigido, crasso, flexuoso, floribus utrinsecus 2–4. *Involucrophorum* crassum, paulo exsertum, apice crateroideum. *Involucrum* cupuliforme vel pateriforme, 1–2 mm. longum; floris aureola neutrius conspicua. *Perianthium* fructiferum explanatum, tepalis interioribus subduplo longioribus quam exterioribus. *Fructus* immaturi tantum visi, ovato-elliptici, cum perianthio rostroque 18 mm. longi, 10–12 mm. in diam. *Squamæ* brunneo-gramineæ, in 15 orthostiches imbricatæ, in linea infra marginali atriores.

Malay Peninsula: **Province Wellesley,** Bukit Juru (Ridley, 7002. Holotype in Singapore). **Penang,** loc. incert. (Gaudichaud, in the Paris Herbarium).

I have not seen the actual specimen collected by Gaudichaud but only its photographic plate given by Beccari (*plate 30* in the *Calc. Ann. XII, 1911*). Apparently Beccari mistook the outermost spathe for one of the internal and so he remarked that the specimen of Gaudichaud in the Paris Herbarium as well as its duplicates in the Geneva and the Florence herbaria bore male spadices without their outermost spathes; and yet the outermost spathe is represented in Beccari's plate of Gaudichaud's specimen. The body of this spathe measures only 18 cm. in length, while the beak, which is placed vertically on the extreme left of the plate, is more than 35 cm. long.

Were it not for the narrow leaflets, the long beaked inflorescence and the narrow spathes, *D. angustispathus* would have been extremely difficult to distinguish from *D. grandis* with which the species was confused by Ridley. Leaf-sheaths are wanted to bring out further differences.

III. Dæmonorops calicarpus (Griff.) Mart., Hist. Nat. Palm. III (1850) 326 t. 175 f. vi.; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 466; Ridl., Mat. Fl. Mal. Pen. II (1907) 174 pro parte; Becc. in Calc. Ann. XII (1911) 94 t. 34; Ridl., Fl. Malay Pen. V (1925) 37 pro parte (ex altera parte = *D. intermedius, D. Lewisianus, D. sepal,* and *D. tabacinus*).

Calamus calicarpus Griff. in Calc. Journ. Nat. Hist. V (1844) 92, et Palms Brit. Ind. (1850) 99 tt. 215-A, B, C and D et t. 216-A f. V and VI. (*Type locality* = Malacca).

Malay Peninsula: **Kemaman,** Bukit Kajang, near Ulu Bendong, alt. 500 ft. (Corner, 30,077; 30,389). **Perak,** Bujong Malacca (Curtis, 3160); Tapak (Ridley, 14,115). **Dindings,**

Lumut (Ridley, 7899; Curtis 3444, female). **Malacca,** Chinana Puteh (Alvins, 979, vern. name *Rotan Chucho Miniak*); Bukit Sadanan (Pun Bebas=Derry's collector, 112, vern. name *Rotan Sabut*). **Selangor,** Kuala Lumpur (Ridley in 1899); Dusun Tua (Ridley, 7878).

IV. Dæmonorops congestus Ridl., Mat. Fl. Malay Pen. II (1907) 178 et Fl. Mal. Pen. V (1925) 40.

The type of this species is a specimen collected by Ridley in Singapore in a place that was called the Stagmount by the English, and Bukit Panjang by the Malays. The specimen does not bear any date or number. After examining a duplicate of the type Beccari reduced the species to *D. leptopus,* making at the same time the following remarks on its status: "I have reduced *D. congestus* of Ridley to *D. leptopus* after a very careful analysis of a specimen kindly sent to me by its author. It is true that this specimen (which is very incomplete, and has very immature fruits) has spikelets with the flowers more approximate than usual; but this specimen does not appear to me quite normal" (cf. *Calc. Ann. XII,* 1911, pp. 128, 131).

As Ridley in his later work did not agree with this reduction made by Beccari, and moreover he insisted in placing the species in section CYMBOSPATHÆ (*D. leptopus* belongs to the section PIPTOSPATHÆ) I re-examined the type of *D. congestus,* which is in the Singapore herbarium, and as a result I fully concur with Beccari's remarks on the status of the species. Apparently Ridley relied for his information of the specific description more on his fieldnotes than on the actual type specimen, and so in his *Flora V, 1925 p. 40,* he repeated the erroneous statement originally made in the *Materials II, 1908, p. 179* even as to the length of the spadix. A fragment of the peduncle of the spadix in the type specimen measures more than 4 inches. This fact and the length of the spikelets or of the portions of partial inflorescences (primary branches) show that the spadix is very long, belonging to the section PIPTOSPATHÆ. Ridley's original statement that the spadix is only 2 inches long was perhaps due to a *lapsus calami* in his fieldnotes for 2 feet long—a mistake that would have been easily detected had Ridley, instead of relying on his notes, re-examined the type specimen before preparing the specific description for his *Flora.*

Two more specimens collected by Ridley on the Stagmount are likewise labelled *D. congestus* by Ridley himself. But, though they both belong to CYMBOSPATHÆ, it is obvious that they did not form the basis of *D. congestus,* for they not only do not agree with Ridley's description of the species, but they were collected only in 1908, a year after the original

publication of the species. These latter specimens, (numbered 13,302), are *D. angustifolius* as interpreted herein.

V. Dæmonorops Curtisii Furtado **spec. nov.**

A *D. Lewisianus*, cui valde affinis, vagina frondium inerme, haud geniculata; spathis inermibus hæc species bene distincta.

Caudex gracilis, cum vagina 8 mm. in diam., erectus vel semiscandens. Frondium *vagina* inermis, haud gibbosa, pro maxima parte atro-ferrugineo leprosa, apice oblique truncata. *Ochrea* inermis, ad 5 mm. longa. *Petiolus* circ. 15 cm. longus, dorso convexus, supra concavusculo-applanatus, inermis vel secus margines dorsumque spinis perpaucis, solitariis, brevissimis vel obscuris remote armatus. Lamina 25–30 cm. longa, secus rhacheos dorsum unguibus indivisis, reduncis, brevibus prædita, in cirrhum ad 10 cm. longum unguiculatum transiens. *Segmenta* circ. 12 cm. longa, 1 cm. lata, ensiformia, apicem quam basin versus magis attenuata; supra secus costam medianam et interdum duas costas subprimarias, subtus secus costam mediam tantum, setulosa; ad margines eodemmodo ciliolata. *Spadix* ante anthesin elongato-fusiformis, cum rostro circ. 12–14 cm. longus; spatha extima inermis, dorso superficialiter bicarinata, in rostrum circiter corpore ejusdem æquilongum contracta. *Perianthium* fructiferum explanatum. *Fructus* immaturi tantum visi, ovati, apicem versus angustati, circ. 12–13 mm. longi, 8–10 mm. in diam. *Squamæ* in orthostichos 15 dispositæ, in medio sulcatæ, basi stramineæ, apicem versus rebescentes, linea marginali fuscente.

Malay Peninsula: **Province Wellesley,** Tasek Glugor (Curtis in April 1902. Type in Singapore).

Obviously an ally of *D. Lewisianus* from which it is easily distinguished by unarmed leaf-sheath, non-gibbous petiole, and unarmed spathes. The two last mentioned characters are sometimes found in the spathes of *D. Lewisianus* produced in the "senile" stages, but even then one can always detect some spines or bristles on the leaf-sheaths and very often on the outermost spathes. Curtis's specimen is evidently taken from the terminal portions of an old stem; because owing to the disarrangement in the rate of growth of the internodes and leaf-sheaths, the spadices appear as if they have originated in the axil of the leaf immediately below it. The basal portion of the spadices being thus caught up in pseudo-axils of the leaves, the outermost spathes do not fall off even after they are detached from the inflorescence axis, thereby making the spathes appear as persistent. Such a condition is sometimes obtained in many rattans in their "senile" stages, that is, stages immediately preceding their death.

VI. Dæmonorops grandis (Griff.) Mart., Hist. Nat. Palm. III (1850) 327 t. 175 f. 9 et t. Z-xii f. 11; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 463, in Rec. Bot. Surv. Ind. II (1902)

219 et in Calc. Ann. XII (1911) 58 t. 11; Ridl., Mat. Fl. Mal. Pen. II (1907) 177 et Fl. Mal. Pen. V (1925) 38. *pro parte.*

Calamus grandis Griff. in Calc. Journ. Nat. Hist. V (1844) 84 et Palms Brit. Ind. (1850) 91 tt. 210 A, B, and C, et t. 216 f. 3.

D. *angustifolius* Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 174 et Fl. Mal. Pen. V (1925) 36 *pro parte.* **Syn. nov.**

D. hygrophilus Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907)178 et Fl. Mal. Pen V (1925) 40 p.p. **Syn. nov.**

D. intermedius Mart. *sensu* Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 464 et in Calc. Ann. XII (1911) 73 t. 20 pro. maj. parte and excl. spec. Griffithianum. **Syn. nov.**

D. intermedius var. *nudinervis* Becc. in Rec. Bot. Surv. Ind. II (1902) 220 nomen nud., et in Calc. Ann. XII (1911) 75 tt. 21 et 22. **Syn. nov.**

D. Kirtong Griff., Palms Brit. Ind. (1850) 102 t. 216 B. **Syn. nov.**

D. malaccensis Mart. tom. cit (1850) 327; Bec. in Rec. Bot. Surv. Ind. II (1902) 222 et in Calc. Ann. XII (1911) 61 quoad t. 216 B. **syn. nov.**

D. malaccensis Mart. *tom. cit* (1850) 327, Bec. in Rec. Bot. Surv. Ind. II (1902) 222 et in Calc. Ann. XII (1911) 61 quoad t. 216 B. **Syn. nov.**

Calamus acanthopis Griff., Palms Brit. Ind. (1850) t. 216 B. **Syn. nov.**

Malay Peninsula: **Kedah,** Kedah Peak=Gunong Jerai (Ridley in 1893), **Province Wellesley,** Tasek Glugor (Burkill, 6536). **Pahang,** Tasek Bera (Henderson, 19484, vern. name *Rotan Relang* and Sakai name=*Chongkak*). **Negri Sembilan,** Bukit Sutu in Sungei Ujong district (Alvins, 1878, vern. name *Rotang Sunang*); Senaling Inas (Holttum 9778, vern. name *Rotang Kerotong*); Tampin (Burkill; 1372; 2551). **Selangor,** Pataling (Ridley on 27-vi-1889) the spathes only. **Singapore,** Bukit Arang (Goodenough, 1660); Bukit Mandai (Ridley in 1890); Changi (Mat in March 1894); Bidadari (Ridley 8957); Ang Mo Kio (Ridley 6672); Bukit Timah (Goodenough in 1892, vern. name *Rotang Chinchin;* Ridley in Feb. 1900; in 1890; 1892; and in 1898); North Selitar (Ridley, 3506 and 3499); Selitar (Goodenough in 1890); Ridley, 3498); Gardens' Jungle (Ridley 5122; 5123* and 5124). **Malacca:** Chinana Puteh (Alvins, 890, vern. name *Rotang Sunang*); Bukit Sadanen (Pun Bebas= Derry's collector, 110, vern. n. *Rotan Chichik Landak*; ibid., 108, vern. n. *Rotang Cheranang*).

* This number is also given to specimens of *D. angustifolius.*

Calamus acanthopis and *Dæmonorops malaccensis* are exact synonyms of *D. kertong*, all the three names being based on the same material referred to as *Rotang Kertong* by Griffith in a foot-note under *C. petiolaris* var. *B.* in Calc. Journ. Nat. Hist. V (1844) 94. As Griffith had considered it to represent a new species but had supplied no botanical name, Martius supplied the name in 1850 by calling it *D. malaccensis*, Griffith's names *Calamus acanthopis* and *Dæmonorops kertong* being published in a posthumous work in the same year. The type material consisted of two spadices [though a portion of radical leaf is also represented in the figure given in Griffith's posthumous work, Palms Brit. Ind. (1850)]. As neither of these spadices nor the leaf portion is in the Calcutta herbarium, and as Beccari, who had examined Griffith's specimens preserved in the Kew herbarium, could not see the type specimens, and as Martius noted that he had seen the spadices, it is to be presumed that the spadices are in Martius's herbarium in Munich. From the drawings given by Griffith, it is evident that the two spadices represent *D. grandis*, each having lost its outermost spathe. The vernacular name *Rotang Kirtong* with its variants is still being used by the Peninsula Malays to denote *D. grandis*, though the name is sometimes used for *Calamus scipionum* or for an allied species or for a species of *Plectocomiopsis*, which, owing perhaps to its tufted growth and broad and distant leaflets, are classed by the Malays with the former. The specimens that Beccari identified as *D. malaccensis* do not belong here (cf. my remarks on *D. melanochætes*).

Ridley gave the number 5123 to specimens taken from more than one clump growing in the Singapore Botanic Gardens. Since a specimen bearing this number was determined by Beccari as *D. angustifolius* (later figured in the Plate 18 of the *Calcutta Annals* XII, 1911), Ridley concluded that all his specimens bearing the same number were *D. angustifolius*, though a greater part of them are *D. grandis*. I think this faulty numbering has been one of the main causes why Ridley was much confused over *D. grandis* and *D. angustifolius* (see my remarks on the latter species).

Ridley has quoted the Pataling specimen (Selangor) and Pun Bebas (=Derry's Collector) n. 110 (from Malacca) under *D. hygrophilus*. But with the exception of the leaf on the former, which by reason of its being from a radical leaf, is not identifiable, both the specimens consist of unopened spadices belonging to *D. grandis*. On Pun Bebas specimen n. 108, *Rotan Cheranang*, is recorded as its vernacular name, but obviously through a mistake for the name *Cheranang* or *Jernang* (or *Jeranang*), is invariably applied by Malays to a *Dæmonorops* species yielding dragon-blood.

In the *Materials II, 1907, p. 178,* Ridley has left the following remarks on *D. grandis*: "I am quite unable to distinguish *D. intermedius* Mart. (*Calamus intermedius* Griff.), though Beccari keeps it separate and describes [?] a variety *D. intermedius* var *nudinervis*. Griffith, the original describer of it, was dubious [?] as to its being distinct, and the two very slightly different forms pass readily into each other. Both grow side by side in the gardens and garden jungle, and as usual in this group there is a great variation in the size of spathe, dimensions of spines, and bristleness of the leaves, according to the age of the plant and its habitat".

These remarks of Ridley are certainly applicable to Beccari's interpretation of *Calamus intermedius* Griff., but not to this species in its original sense. Griffith's species is allied to *D. Lewisianus,* having much narrower and closer leaflets than in *D. grandis.* (cf. my remarks on *D. intermedius*). Another important character that distinguishes *D. intermedius* from *D. grandis,* and which was also noted by Griffith, lies "in the armature of the spathes, the thorns of which are very slender, more deflexed, and much more numerous". Beccari's *D. intermedius* var. *nudinervis* was included in Griffith's *D. grandis* as the leaflets of the latter were described as being "without setæ on either surface or along the margins, or with the midvein setigerous on both surfaces, as well as on the margins."

Griffith's plate 211-A of *D. intermedius* is also very clear and cannot be easily mistaken for *D. grandis.* It approaches some forms of *D. angustifolius* with rather distant leaflets and narrower thorns on the spathes. (cf. my remarks on *D. intermedius*).

Ridley gives *Rotan Sumang* as a vernacular for the species, but Alvins spells the name as *Rotang Sunang.*

VII. Dæmonorops hygrophilus Griff. ex Mart., Hist. Nat. Palm III (1850) 204 et 328, t. 177 f. II; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 464; Ridl., Mat. Fl. Mad. Pen. II (1907) 178 quoad specimen Griffithianum tantum; Becc. in Calc. Ann. XII (1911) 62 t. 13; Ridl., Fl. Mal. Pen. V (1925) 40 pro parte.

Calamus hygrophilus Griff., Palms Brit. Ind. (1850) 96 t. 213-C. (Basinym) Malacca.

D. angustifolius Mart. *sensu* Ridl. in Journ. Roy. Asiat. Soc. Str. Br. 57 (1910) 110 pro parte. **Syn. nov.**

?D. fissus var. *cinnamomeus* Becc. in Calc. Ann. XII (1911) 67 t. 16.

Malay Peninsula: **Perak,** R. Temango (Ridley, 14,719, male only; female = *D. angustifolius*). **Kemaman,** Ulu Kajang,

alt. 500 ft. (Corner, 30,447, vern. name *Rotan Tawar*). **Selangor,** Telok Forest Reserve (Burkill, 6520). **Malacca,** loc. incert. (Fernandez, vern. name *Rotan Ayer*. Type; not seen). **Johore,** Kota Tinggi, by Sungei Johol (Corner, 29,750). **Singapore,** Bukit Panjang, at Stagmount (Ridley, in 1907).

SUMATRA: **Palembang,** Lematang Ulu, alt. circ. 500 (Grashoff, 196=Herb. Bog. n. 404, vern. name *Uwi Getah*); between Banjuasin and Kubus, alt. 60 feet (Grashoff, 639, vern. name *Rotan Kelemunting*) (both specimens from herb. bogor.).

BORNEO; **Pontianak** (Heyne, 2548=Herb. Borgor. n. 222, in herb. Bogor.). **Sarawak,** Bau (Ridley 11,826).

The species, which had up till now been regarded as endemic in the Peninsula, was not clearly defined, and its status had therefore been rather doubtful. I have not seen Scortechini's specimen cited by Beccari, but from its plate, Beccari's identification appears to be correct. The type is not in the Calcutta herbarium, but might be found in the Munich herbarium, where Griffith had sent the material for Martius's study. But the two plates by Martius, and by Griffith, bring out clearly the characters in the petiole that distinguish the species from *D. angustifolius*. *viz.*, Geniculum unarmed, or armed only along the ridge with a few, small, rigid prickles; and the petiole armed along the margins, and occasionally with a few solitary prickles along the dorsum. In addition the spathes and sheath are usually blackish with crustaceous indumentum. In *D. angustifolius,* the geniculum and both the surfaces (occasionally one) of the petioles are armed with scattered rigid prickles. The spines on the spathes and also on the leafsheaths of *D. hygrophilus* are short and narrow, and scattered; not broad and long, often laciniate and very close, as in *D. angustifolius.*

The Singapore and the Johore material is fruiting and shows that the scales are arranged in 16-18 vertical series. The mature fruits (in the Singapore specimen) are ovoid-globose, depressed at base, shortly beaked at apex, 14–15 mm. in length (excluding the beak), 15–17 mm. in diam. They resemble very much the fruits of *D. angustifolius* but are lighter coloured.

The Sumatran material cited above, which was obtained from the Buitenzorg herbarium on loan, has been named by Beccari as *D. trichrous* Miq. The Bornean material, which appear to be *D. fissus* var. *cinnamomeus* may belong here.

VIII. Dæmonorops intermedius (Griff.) Mart., Hist. Nat. Palm. III (1850) 327 t. 175 f. 8; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 464 et in Calc. Ann. XII, (1911) 173 quoad specimen Griffithianum (altera=*D. grandis*).

Calamus intermedius Griff. in Calc. Journ. Nat. Hist. V (1844) 86 et Palms Brit. Ind. (1850) 93 t. 211 A and B (*Type locality*=Malacca).

D. calicarpus Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 174 et Fl. Mal. Pen. V (1925) 37 pro parte. **Syn. nov.**

D. grandis Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 177 et Fl. Mal. Pen. V (1925) 38 quoad syn. *D. intermedius*. **Syn. nov.**

Malay Peninsula: **Malacca,** loc. incert. (Fernandez, vern. name *Rotan Crysa*. Type in Calc. Herb.). **Johore,** Bukit Soga (Ridley, 11,205, female specimen only; male=*D. melanochætes*).

The type specimen in the Calcutta herbarium is in a fragmentary condition and without external spathes, which, however, seem to have been present when Beccari examined it. This specimen has given rise to a considerable confusion, because the absence of the spathes, in addition to the incompleteness of the extant parts, makes extremely difficult the identification of the species with any certainty. Anyhow, that it cannot be the species accepted as such by Beccari is evident, for that has very broad leaflets, whereas Griffith's description and the specimen itself indicate that *D. intermedius* is a narrow-leaved species like *D. angustifolius* and *D. Lewisianus*.

Beccari's interpretation of *D. intermedius* was based on Scortechini's collection that seems to have been so mixed with parts of another species that Beccari must have been misled to regard all the specimens in the collection as having been derived from the same plant or clump; and presumably this is the reason why he explained away the differences he detected principally in the armature of the outermost spathes by considering the species as very variable or polymorphous. From Beccari's plate 20, I would regard the detached spathe (on the right hand side of the plate) to be *D. angustifolius;* but obviously the major part of *D. intermedius* sec. Beccari is *D. grandis*.

In making the identification of *D. intermedius* in the Griffithian sense, I have used the type specimen together with the description and the plates publised by Griffith. The important clue to the identification of Griffith's species with Ridley's specimen quoted above is the armature of the second spathe, which is noted by Griffith as thickly armed. There are only two species known to occur in the Malay Peninsula (in Malacca or in its neighbourhood), that would answer this description: the one is represented by the specimen I refer here to *D. intermedius;* and the other is *D. melanochætes*. The latter, which also produces spathes very like the example depicted by Griffith, bears bristles down to the very base of the inflorescence and even on the peduncular part that is adnate to the sheath, the bristles in the latter part being as a rule very closely set. There are

also noticeable differences in the armature on the basal portion of the petiole and on the apex of the sheath in these two species, *D. melanochætes* being more thickly and conspicuously armed in these parts than *D. intermedius*. In Ridley's specimen quoted above the spadix is practically unarmed at the base; and Martius, who had seen a specimen from Griffith, described the peduncle as "subinermis". But *D. intermedius* as interpreted here appears to be a very close relative of *D. melanochætes*, and observations in the field and better herbarium specimens are necessary to determine whether the former species represents merely an ecologic or varietal form of the latter. To achieve this purpose, it would be useful if the collectors could procure specimens showing the full range of variability of sheaths and spathes in the two species. See also my remarks on *D. melanochætes*, *D. grandis*, and *D. monticolus*.

IX. Dæmonorops javanicus Furtado **spec. nov.**
D. stenophyllo et *D. singalano* propinqua est, sed ab illo spatharum spinis subacicularibus valde gracilioribus ac pluribus; et ab hoc spadicibus sessilibus vel penduculis valde brevioribus, erectis, haud reflexis, hæc species facile distingui potest. A grege, cui *D. angustifolius* pertinet, spatharum spinis valde gracilioribus; fructibus immaturis sphæroidioribus, haud elliptico-ovatis; squamis (margine albescente excepta) fere concoloribus, cum canaliculo profundiore differt.

Caudex scandens, cum vagina 2.5-3 cm. in diam.; frondibus magnis cirrhiferis. *Vagina* frondium infra petiolum gibbosa, apice suboblique truncata, aculeis laminaribus, elasticis schistosis, ad 3.5 cm. longis, basi 3.4 mm. latis, per series obliquas interruptasque confluentibus, apice eiusdem spinis longioribus, porrectis. *Petiolus* 15 cm vel longior, subtus secus dorsum aculeis dimensione variablilibus dispersis, in geniculo ad dorsum tantum armatus, supra canaliculatus lævigatus, inermis. *Lamina* magna, in cirrhum terminans, secus rhacheos dorsum unguibus 3-7-fidis armata. *Segmenta* plura, ensiformia, 2.5–3.5 cm. inter se remota; 30-38 cm. longa, 13-18 mm. lata, maxima latitudine infra medium sita, apicem versus sensim acuminata, basi abrupte contracta, plicatula, nervis transversalibus conspicuis; supra ad costas duas laterales et margines, ad costam mediam in tertia parte terminale tantum, setulosa; subtus inermia. *Inflorescentiæ* foemineæ sessiles vel pedunculo 1– 1.5 cm. longo praedita, cum rostro 5-7 cm. longo, inermi vel fere, 22-25 cm. longæ. *Spathæ primariæ*: *infima* cymbiformis, bicarinata, aculeis 1-2.5 cm. longis, subacicularibus, basi 1–2 cm. latis, solitariis vel confluentibus armata; *interiores* inermes, conspicue nervosæ. *Spathæ secundariæ* bracteiformes amplectentes. *Spathellæ* consimiles, in apicem triangularem involucrophorum æquantem vel superantem productæ. *Involucrophorum* obconicum obsoleto angulatum, apice in cupulam asymmetricam oblique truncatam

expansum. *Involucrum* cupulare, truncatum, in involucrophoro fere totum immersum. *Perianthium* fructiferum explanatum. *Fructus* immaturi tantum visi, globosi, 10–12 mm. in diam (sine apiculo 2-3 min. longo). *Squamæ* per series 15-18 imbricatæ, concolores vel fere, fusco-gramineæ, secus marginem albescentes, apice atrescentes, dorso conspicue-canaliculatæ.

JAVA: **Preanger,** Gedeh (Heyne, 2,670=Herb. Bogor. num. 468. Holotype in Herb. Bogoriensi).

Besides the widely distributed, polymorphous *D. melanochætes,* no *Dæmonorops* of the section Cymbosthæ had been recorded from Java. *D. javanicus* records therefore another species of the section for Java. The nearest ally of this are the mountain species of Sumatra and the Malay Peninsula, belonging to the group of *D. singalanus.* The leaflets are quite unarmed in the lower surface, a condition that might not be constant in the species. In the gibbose part of the petiole there is a band on either side of the ridge where the spines are absent, though a little further on in the sheath (in the portion that may be called the wings of the puckered part of the petiole) the spines are both conspicuous and large.

X. Dæmonorops Lewisianus (Griff.) Mart., Hist. Nat. Palm. III (1850) 327 t. 175-iv f. 1-7 excl. specimen Gaudichaudianum; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 465; Ridl., Mat. Fl. Mal. Pen. II (1907) 176 pro parte (ex altera parte=*D. melanochætes* and *D. grandis*); Becc. in Calc. Ann. XII (1911) 87 t. 30 pro parte (ex altera parte= *D. angustipathus*); Ridle., Fl. Mal. Pen. V (1925) 38 partim.

Calamus Lewisianus Griff. in Calc. Journ. Nat. Hist. V (1844) 87, et Palms Brit. Ind. (1850) 94 t. 212. Type locality= Penang.

D. angustifolius Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 174 et Fl. Mal. Pen. V (1925) 36 pro parte. **Syn. nov.**

D. calicarpus Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 174 et Fl. Mal. Pen. V (1925) 37 pro parte. **Syn. nov.**

D. microthamnus Becc. in Rec. Bot. Surv. Ind. II (1902) 221; Ridl., Mat. Fl. Mal. Pen. II (1907) 175; Becc. in Calc. Ann. XII (911) 92 t. 32; Ridl., Fl. Mal. Pen. V (1925) 37. **Syn. nov.**

D. monticolus var. B Becc. in Rec. Bot. Surv. Ind. II (1902) 221 *nom. nud.*

D. monticolus Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 175 et Fl. Mal. Pen. V (1925) 37 pro parte (quoad specimina penangensia) **Syn. nov.**

D. monticolus var. *pinangianus* Becc. in Calc. Ann. XII (1911) 85 t. 29 excl. tab. Griffithianam. **Syn. nov.**

D. petiolaris Mart., Hist. Nat. Palm. III (1850) 326 t. Z-xviii f. 3; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 466 et in Calc. Ann. XII (1911) 90 t. 31. **Syn. nov.**

D. petiolaris var. *nudipes* Becc. in Rec. Bot. Surv. Ind. II (1902) 221. **Syn. nov.**

C. monticolus Griff. *sensu* Griffith, Palms, Brit. Ind. (1850) 97 quoad specimen penangense. **Syn. nov.**

C. petiolaris Griff. (incl. vars. A and E) in Calc. Journ. Nat. Hist. V (1844) 93, et Palms Brit. Ind. (1850) 101 t. 216 f. vii. **Syn. nov.**

Malay Peninsula: **Penang,** loc. incert. (Griffith, in Calc. Herb.; Lewis vern. name *Kichun,* in Calc. Herb. Type of *D. Lewisianus;* Curtis, 2232); Waterfall (Burkill, 376); Penara Bukit (Curtis, in July 1893); Penang Hill = Government Hill (Abrams, in 1893; Ridley: 7034; 7895; 7896); Balik Pulau (Ridley; 7900; 7902); Moniots Road (Curtis, 764). **Province Wellesley,** Bukit Juru (Ridley; 7003; 7102). **Dindings,** Pangkor (Ridley, 7897, vern. name *Rotan Kusom*); Lumut (Ridley in Feb. 1892; Curtis, 3444, male specimens only, female specimens = *D. calicarpus*, vern. name Rotan Chuchok). **Perak,** Pulau Rumbia (Seimund, on 15-iii-1925); Gunong Kledang (Curtis, 3351, male and female). **Malacca:** loc. incert. (Griffith, in Calc. Herb).

Sumatra: **Lingga Archipelago:** Pulau Selajar (Bünnemeijer, 7451 in Herb. Buitenzorg); Pasir Panjang (Biinnemeijer, 7016);

At first I thought *D. petiolaris* to be a good species, but after comparing the material with that of *D. Lewisianus,* I find difficulty in keeping it as a species quite distinct from the latter. Ridley's 9897 from Dindings, Ridley's 7003 from the Province Wellesley, Seimund's specimen from the Rumbia island in Perak, Curtis's 3351 (male) from Perak, and Burkill's 376 and Ridley's 7895 from Penang form, so to say, the transitional stages between the extreme forms, which may be called *D. monticolus* var. *pinangianus* and *D. petiolaris.* Griffith's specimen cited here as from Penang bears no locality and is named *Calamus monticolus* var. *E* (= *D. monticolus*); but in all probability it is the Penang specimen Griffith cited under *C. monticolus,* in his second monographic work on Palms (1850). Regarding the armature of its spathes and the apical wings of the leaf-sheaths, the specimen agrees well with Ridley's n. 1895, though the latter is much less leprose. The authentic specimen of *D. petiolaris* (Griffith's specimen from Malacca cited above), which consists of a terminal portion of a radical leaf and an entire upper leaf with its sheath, is too meagre to be of any great help in the identification of the species. The upper leaf measures about 12 inches and the petiole is not terete. Similar leaves are produced by forms of *D. calicarpus* as interpreted here

and so I think Beccari's acceptation of this species is correct, though the species has to be considered as a synonym of *D. Lewisianus*.

The type specimen of *D. Lewisianus* in the Calcutta herbarium (the Penang specimen collected by Lewis) was derived from rather thick rattan and does not correspond to Griffith's plate 212 which is a representation of a terminal portion of the stem approaching a stage referred by Beccari to *D. petiolaris*. In its shape, armature and indumentum this type specimen, which has lost the terminal portion of its spadix, corresponds to Ridley's 7902 referred by Beccari to *D. monticolus* var. *pinangianus*. The species varies a great deal not only in the size and shape of the spadices but also in the length and bristleness of the peduncle; but no important differences can be found to keep these various forms separate as varieties or species. The indumentum on the leaf-sheaths, petioles, and external spathes is also variable, being in some cases very thick and persistent and in others entirely or almost deciduous very early during the course of the development of the organs. These differences are perhaps due to the age and the habitat of both the individual plants as well as of the clump, the suckers produced at a time when the soil around it has been exhausted by preceding suckers and when the competition for space and light has become very acute, becoming very stunted and weak. Perhaps Curtis's 3351 (female) from Gunong Kledang in Perak, which corresponds to Beccari's plate 32 of *D. microthamnus*, represents such a stunted plant, while Lewis's specimen in the Calcutta herbarium and Ridley's 7902 in the Singapore herbarium (forma *D. monticolus* var. *pinangianus*) represent forms produced at a time when the competition between the suckers of the clump for space, food, etc. is not so keen and therefore does not affect the vigour and luxuriance of the individual plants.

The specimen Gaudichaud collected in Penang (preserved in the Paris herbarium), and which Beccari referred to *D. Lewisianus*, is referrable to *D. angustispathus*.

Beccari also referred Ridley's specimens no. 9466 from the Kew and the Calcutta herbaria to *D. Lewisianus*. Beccari's description of these specimen is applicable to Ridley's 9466 in the Singapore herbarium, which I cite under *D. melanochætes*.

XI. Dæmonorops melanochætes Bl. in Roem. et Schult., Syst. Veget. VII (1830) 1333 excl. syn.; Mart., Hist. Nat. Palm. III, ed prima (1836 ?) 198 t. 117 f. II et ed. 2 (1850) 203 et 326 Kunth, Enum, Pl, III (1841) 202; Blume, Rumphia II (1845 ?) tt. 134 et 137, et III (1849) 3; Miq., Fl. Ind. Bat. III (1855) 68, Becc. in Rec. Bot. Surv. Ind. II (1902) 219, et in Calc. Ann. XII (1911) 47.

D. angustifolius Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 174, et Fl. Mal. Pen. V (1925) 36, pro parte. **Syn. nov.**

D. Lewisianus Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 176 p.p.; Bec. in Calc. Ann. XII (1911) 87 p.p.; Ridl., Fl. Mal. Pen. V (1925) 38 pp. **Syn. nov.**

D. malaccensis Mart. *sensu* Becc. in Calc. Ann. XII (1911) 61 t. 12 (excl. spec. Griffithianum) **Syn. nov.**

D. monticolus Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 175 quoad specimina borneensia; Becc. in Calc. Ann. XII (1911) 84 quoad specimen Ridleyanum; Merr., Enum. Bornean Pl. (1921) quoad loc. Borneo tantum; Ridl., Fl. Mal. Pen. V (1925) 37 quoad Borneo. **Syn. nov.**

Calamus melanochætes (Bl.) Griff. in Calc. Journ. Nat. Hist. V (1844) 86, et Palms Brit. Ind. (1850) 92 in nota; Miq., Palm. Arch. Ind. (1868) 28.

D. Schmidtianus Becc. in Schmidt., Fl. Koh Chang IX (1909) 330; et Calc. Ann. XII (1911) 52 t. 7. **Syn. nov.**

? *D. Hallierianus* Becc. in Calc. Ann. XII (1911) 218 t. 99 quoad specimen Hewittianum. ? **Syn. nov.**

Malay Peninsula: **Kemaman,** Bukit Kajang alt. 500 ft. (Corner, 30428). **Pahang:** *Pulau Tioman*: at Sedagong, alt. 1,000 ft. (Nur, 18891); Bukit Surin alt. 1,000–2,000 ft. (Henderson, 21710); Joara Bay (Burkill: 983, vern. name *Rotan Langah*; 1016). **Penang,** Moniot Road (Ridley, 9466). **Province Wellesley,** Bukit Juru (Ridley 7100). **Negri Sembilan,** Gunong Tampin (Holttum 9561). **Johore,** Serom (Ridley, in Nov. 1900); Bukit Soga (Ridley, 11205, male only; the female bearing this no. = *D. monticolus*). Pulau Aor, alt. circ. 600 ft. (Henderson 18358).

Borneo: **Sarawak,** Satubong (Hewitt, in 1906, vern name *Rotan Bahut*); Matang (Ridley, in July 1903); Quop, (Hewitt, 23-iv-1907, n. R.A.).

This species was recorded by Beccari for Java, Borneo and Sumatra, but not for the Malay Peninsula, though Martius had recorded as occuring in the Malay Peninsula in the island of Penang. Merrill (Univ. Calif. Publ. Bot. XV 1929, p. 24) refers to this species Elmer's specimens n. 21102 from Tawao in British North Borneo, but the duplicate material (consisting of a few fruits and leaflets) in the Singapore herbarium does not appear to represent this species.

The Peninsular material of the species has been much confused by Beccari and others. Beccari has regarded Ridley's n. 11205 (male) from Johore as *D. malaccensis* (Griff.) Mart., while he determined a similar specimen collected by Ridley in Penang sub. n. 9466 as *D. Lewisianus* (Griff) Mart. Previous to the

issue of his monograph on Dæmonorops (1911) Beccari communicated his determinations to Ridley, who took it for granted that Beccari's acceptation of the two species of Griffith were correct; and as both the specimens referred by Beccari to the above two species were conspecific, Ridley made *D. malaccensis* a synonym of *D. Lewisianus*, interpreting the species in the sense given to them by Beccari. On a sheet belonging to *D. melanochætes*, Ridley also noted that a plant conspecific with the specimen was cultivated in the Kew Gardens under the name of *D. Lewisisanus* If so, I suspect that this name was given to the plant after its determination by Beccari.

In the first and the second editions of the *Historia*, and also in its *Appendix*, Martius quoted under *D. melanochætes* Bl. a specimen collected by Wallich in Penang. This reference has been noted by Griffith, Kunth, Miquel, etc. In the *Calcutta Annals XII*, 1911, p. 47 Beccari has cited all the references under *D. melanochætes* without making any exclusions, though he does not credit the species to the Malay Peninsula. Neither he, nor Ridley has tried to identify the Wallichian specimen from Penang. Presumably the specimen is not at Kew; and a search may have to be made in Martius' herbarium in Munich* Similarly the Philippine material referred by Martius under this species has to be examined to see whether it had been rightly identified; for neither Beccari nor Merrill (Enum. Philipp. Pl. I, 1922) credits the species to the Philippines.

The Peninsula material of *D. melanochætes* varies a great deal regarding the spininess of the spathes, and the width and the remoteness of its leaflets; and I am unable to say whether or not this variability is dependent on the age and the habitat of the plants. But according to Beccari, this species seems to vary extremely even in Java itself, and so before separating the various forms into distinct varieties, one will have to devote a great deal of time to study the variations due to the age and the habitat of the plants. Some of the Peninsular forms look (*e.g.* Henderson n. 21710) exactly like Beccari's plate of *D. Schmidtianus* from Koh Chang Island off the coast of Siam, while some others (*e.g.* Corner, 30428) like Blume's plate 134, with the exception of the armature of the basal part of petiole, which appears to have been wrongly depicted as having numerous acicular spines; while still others could be easily mistaken for

* A specimen from Wallich's herbarium consisting of a spadix without the outermost spathe is in Martius's herbarium in Munich. From the photograph kindly sent to me by Prof. M. BURRET of the Berlin Herbarium, it appears to be the subject of Martius's plate 117 fig. I.; but I am unable to decide whether the specimen is really *D. melanochætes*, and not *D. grandis* which also has its second spathes somewhat similarly armed. The plate of Martius depicts the thorns on the second spathes with very much swollen bases as in *D. grandis*, whereas the second spathes in *D. melanochætes* and *D. intermedius* have thorns less tumescent at base.

D. intermedius or *D. monticolus;* in fact so great is the resemblance of the armature and shape of some spadices in our material to Griffith's plate 211-B (*D. intermedius*) that I had at first thought to have recognized the latter in *D. melanochætes*. But Griffith's plant is at once distinguished in having peduncled spadices and in being quite bare on the peduncle as well on its portion that is decurrent on the sheath. These characteristics were described for *D. intermedius* by Griffith and can be noticed both in Griffith's plate and the type specimen preserved in the Calcutta herbarium. On the other hand the spadices in *D. melanochætes* are sessile and thickly armed with nigrescent spines up to the base and often also on the decurrent peduncular part.

The Bornean material cited above was referred by Ridley to *D. monticolus,* a species Merrill credited for Borneo on Ridley's authority. Beccari suggested the possibility of the material belonging to *D. Hallierrianus*; and indeed Beccari's plate 99 fig. 3, which is of the specimen collected by Hewitt in Quop, seems represent *D. melanochætes*.

Possibly Ridley's n. 11461 from the Government Hill in Penang also belongs here, but the petiole is not typical.

The beak of spadices may be longer or shorter than the body. The fruit scales are arranged in 15-19 vertical series.

XII. Dæmonorops monticolus (Griff.) Mart., Hist. Nat. Palm, III (1850) 328 t. 175 f. v; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 465 et in Rec. Bot. Surv. Ind. II (1902) 221; Ridle., Mat. Fl. Mal. Pen. II (1907) 176 pro parte et excl. specimina borneensia; Becc. in Calc. Ann. XII (1911) 84 excl. specimen Ridleyanum; Ridl., Fl. Mal. Pen. V (1925) 37 pro parte.

Calamus monticolus Griff. in Calc. Journ. Nat. Hist. V (1844) 90, Palms Brit. Ind. (1850) 97 tt. 214 A, B, & C (excl. spec. pinangense) Type locality=Malacca).

D. angustifolius Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 176 et Fl. Mal. Pen. V (1925) 36 pro parte. **Syn. nov.**

D. monticolus var. *pinangianus* Becc. in Calc. Ann. XII (1911) 85 quoad tabulam Griffithianum. **Syn. nov.**

Malay Peninsula: **Malacca,** Bukit Dusun Paya (Alvins, 1217, vern. name *Rotan Miniak*). **Negri Sembilan,** Gunong Tampin (Goodenough, 1857).

The two specimens cited above agree very well with Griffith's plate and specific description and represent a species likely to be confused with *D. Lewisianus* from Penang (as Griffith had done). The authentic specimen in the Calcutta herbarium appears to be the Penang specimen that was referred here by Griffith in his second work, and which I cite under *D.*

Lewisianus. The Malacca species, *D. monticolus*, seems to be closely related to the latter, but the absence of leaf-sheaths and petioles in the two specimens at my disposal precludes a deeper inquiry into the affinities existing between the two species.

Beccari interpreting *D. monticolus* attached undue importance to the following words in Griffith's Latin diagnosis: "*spatha extima secus carinas duas spinis gracilibus deflexis armata*"; for this description, if taken to mean that the spines are present only along the two carinæ, corresponds neither to Griffith's description in English, nor to his plates 212-B and C. The English rendering of the description of the outermost spathe runs thus:—"*The outer one* [*spathe*] *16–17 inches long, bicarinate, armed between and along the carinæ with weak long, subulate, deflexed, black spines*":

In view of this I regard both Griffith's plates as representing the typical plant.

At first sight, *D. monticolus* might be mistaken for some forms of *D. melanochætes* and for *D. intermedius*, and in fact Griffith's plates of the last and the first mentioned species show many points of resemblance. But unlike that of *D. intermedius* or of *D. melanochætes* the second spathe of *D. monticolus* is unarmed, or armed only with a few bristles here and there towards the apex and along the carinæ, a probable reason why the species was confused by Griffith himself with *D. Lewisianus*. The peduncular portion may be armed or unarmed.

Both the specimens quoted above were cited by Ridley under *D. angustifolius*. See also my remarks under *D. melanochætes*, *D. grandis*, and *D. Lewisianus*.

XII. Dæmonorops pseudo-sepal Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 465; Ridl., Mat. Fl. Pen. II (1907) 180; Becc. in Cale. Ann. XII (1911) 79 t. 25; Ridl., Fl. Mal. Pen. V (1925) 40 inter species dubias.

D. bakauensis Becc. in Calc. Ann. XII (1911) 221 t. 100 **Syn. nov.**

Malay Peninsula: **Johore,** Pulau Tinggi (Burkill, 866).

Sumatra: **Banka Archipelago.** Bakau Isl. (Teysmann, herb bogor. n. 277, type of *D. bakauensis*, vern name *Rotan* Rundang); Banka, on Bukit Tampang, near Sungei Liat (Bünnemeijar, 1736, vern. n. *Rotan rondang*); Banka by Sungei (Teijsmann, herb Bogor. n. 269, bern n. *Rotan Rundang*); Banka on Gunong Menumbing, near Muntok (Bünnemeijer, 1465, vern name *Rotan Getah*). (All the Sumatran specimens are from the Buitenzorg herbarium).

The species appears to represent a form midway between *D. Lewisianus* and *D. grandis*. In fruits and in the armature

of its leaf sheath, the species resembles very much *D. grandis*, but the leaflets are much narrower and the spadices shorter. The species should be included among the *Dæmonorops* having sessile or subsessile spadices, and not among those which have stalked spadices. Judging from the outermost spathe present in Bunnemeijer's 1736, the species appears to be closely related to *D. Binnendijki* Becc.

Beccari separated *D. bakauensis* from *D. pseudosepal* because of the broader leaflets and smaller, ovoid fruits in the former; but the fruits in the type specimen are young. Bünnemeijer's specimen 1465 shows both kinds of leaflets and the fruits which are better developed than in the type of *D. bakauensis* are spherical as in *D. pseudosepal*. In view of this I do not see any reason to maintain *D. bakauensis* as a good species.

XIV. Dæmonorops sepal Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 469 et in Calc. Ann. XII (1911) 77 t. 24; Ridl., Fl. Mal. Pen. V (1925) 36.

D. aciculatus Ridl., Mat. Fl. Mal. Pen. II (1907) 176 et Fl. Mal. Pen. V (1925) 38; Becc. in Calc. Ann. XII (1911) 231 inter species dubias. **Syn. nov.**

D. angustifolius Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 174 quoad syn. *D. sepal* Becc.

D. calicarpus Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 174 et Fl. Mal. Pen. V (1925) 37 pro parte. **Syn. nov.**

D. hygrophilus Mart. *sensu* Ridl., Fl. Mal. Pen. V (1925) 40 pro parte. **Syn. nov.**

D. imbellis Becc. in Rec. Bot. Surv. Ind. II (1902) 220; Ridl., Mat. Fl. Mal. Pen. II (1907) 179; Becc. in Calc. Ann. XII (1911) 80 t. 26; Ridl., Fl. Mal. Pen. V (1925) 41 inter species dubias. **Syn. nov.**

Malay Peninsula: **Perak,** Gunong Hijau (Ridley in 1892, female. Syntype of *D. aciculatus*); *ibid.*, southern summit, alt. 4,300 ft. (Burkill and Haniff: 12763; 12944); Sungei Mengkarau in Larut Hill (Anderson: 176; 166); Maxwell Hill (Ridley, in June 1893, male. Syntype of *D. aciculatus*). **Selangor,** Sempang Mines (Ridley, 15876). **Pahang,** Sungei Lemoi at Ulu Anak (Dolman, 28157); Cameron Highlands by Sungei Ikan near Ulu Telom, alt. 4,500 ft. (Dolman, 27631, vern. name *Rotan Baik*); Fraser Hill alt. 4,000–4,370 ft. (Burkill. and Holttum, 7785).

The fruiting specimens may be arranged in three classes according to the number of the series into which the scales are arranged on fruits, *viz*:—

(*a*) 15 series: Burkill and Haniff: 12944 and 12763.
(*b*) 15–17 series: Ridley on Gunong Hijau; Dolman: 28157 and 27631.
(*c*) 18 series: Anderson 176.

The fruits in Burkill and Holttum, 7785 are injured and so the number of the scale series cannot be counted. Anderson's 176 bear some fruits which are globose as in Beccari's plate of *D. Scortechinii,* though other fruits are normal. This shows the possibility of *D. Scortechinii* being but a form of *D. sepal.* Ridley's specimen from Gunong Kledang has a very diffuse spadix in fruit resembling that of *D. imbellis.* Some spadices I have seen are distinctly ventricose and nodding, some straight and not so ventricose. I think this variability is due to the vigour of the plants and of the spadices.

Ridley based his *D. aciculatus* on two specimens he had collected in Perak. He gave the length of the peduncle as 4 inches, misjudging as free the decurrent portion of the peduncle that has become detached off the sheath on being pulled in the living state. The actual length of the peduncle in Ridley's specimens is about 3–4 cm. only. But the species itself is very variable in respect to the length of peduncles. In the Maxwell Hill specimen quoted above the spadix bears a peduncle which is somewhat longer than in all the others I have so far examined, and apparently is nodding as in *D. imbellis;* in some other specimens the peduncle is subsessile or hardly measurable. This variability in length of peduncles and in the number of the vertical series into which the fruit scales are arranged, as well as a comparison of the plates 24 and 26 given by Beccari with the specimens in the Singapore herbarium lead me to consider *D. aciculatus, D. imbellis,* and *D. sepal* as conspecific.

XV. Dæmonorops sepal var. **pahangensis** Furtado **var. nov.**

A forma typica spatha infima aculeis subulatis vel setiformibus appressis vel arrectis atro-fuscis densissime armata (spatharum *D. melanochætes* Bl. instar) hæc varietas differt. Fructuum squamæ per series verticales 18 imbricatæ.

Malay Peninsula : **Pahang,** Fraser Hill, alt. 4,000 ft. (Nur. 11208. Holotype in Singapore).

The petiolar and laminar portions, present in the specimen, appear to be of the radical leaves. The petiole, which is covered with brown indumentum, bears long and short spines all over on the dorsal side, the longest spines being 3 cm. long. At the mouth of the sheath the spines are still longer (up to about 6 cm.). Leaflets about 40 cm. long. 2.5 cm. wide, unarmed beneath or occasionally with a few prickles in the apical half of the midrib beneath; in the upper surface the 4 lateral nerves, and occasionally the mirdib also, are remotely setulose. The spadix with its fruits is like the typical of *D. sepal.*

D. sepal is a long climbing rattan; but this variety has been noted by the collector as short stemmed plant. The collector's notes run thus : "Stem short, heavily armed with straight spines.

Leaves 6–7 ft. long, armed with straight spines. No leaf-flagellum. Fruits pale green edged brown." Further field observations are needed to see whether this variety represents *D. sepal* in the early stages of its development, for I note in the apical parts of the outermost spathes a tendency for the softer bristles to fall off and become like that of *D. sepal.*

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PALMÆ MALESICÆ.

VII.—Two new CALAMI from the Buitenzorg Gardens.

By C. X. Furtado,

Botanic Gardens, Singapore.

Early this year (1936) I noticed cultivated in the Botanic Gardens, Buitenzorg, Java, two *Calami* showing some characters that are rather infrequent in the genus, and on further study both proved to be new. The one, *C. Steenisii*—named in honour to Dr. C. G. G. J. van Steenis of the Buitenzorg Herbarium, who had taken a great deal of trouble to facilitate my studies during my visit to the Gardens—is recorded to have been introduced from New Guinea, and possesses so many anomalous characters that it cannot be made to fit in any of the sixteen groups into which the genus *Calamus* has been divided by Beccari (*Ann. Roy. Bot. Gard., Calcutta,* XI, 1908, pp. 64–69), though it shows, at the same time, several marks of affinity to some of the New-Guinean species belonging to *Group V* (*vide infra*). The second, described here as *C. inopitatus,* is of unknown origin. It is a stemless palm and produces leaflets which are covered in the under surface with minute pinkish tomentum, both of which characters are not common in the genus. It is closely related to *C. Burckianus* Becc. from Java, a member of *Group II* of Beccari and possibly also stemless.

Calamus Steenisii Furtado **spec. nov.** (*Planta fœminea tantum visa*). *Caudex* soboliferus, alte scandens, circ. 17 m. longus, cum vagina 2.5 cm. in diametro. *Vagina* frondium flagellifera, infra petiolum gibbosa, furfureo ferrugineo, deciduo, dense leprosa, aculeis numerosissimis, tenuibus, applanato-acicularibus, primum ferrugineis, mox lævigatis, stramineis per series transversales interruptas, 3–5 mm. inter se remotas dispositis, basi connatis, in partibus liberis fragilibus armata. *Ochrea* papyracea, exsuccosa, fibrosa, auriculo-lanceolata, circ. 50 cm. longa, e basi 2.5 cm. lata in apicem acuminatissimam interdum fissam transiens, intus lævigata, extus obscure bicarinata, deciduo fusco leprosa, spinis, flaccidis, laminaribus, exsuccosis, solitariis, vel basi connatis, ad 6 mm. longis prædita. *Petiolus* subtus convexus, usque geniculi basin inermis, supra applanatus, basin versus concavusculus, secus margines aculeis 3–4 mm. longis, rigidis per tres lineas dispositis armatus, furfureo fusco deciduo leprosus, 8–12 cm. longus, ad 1 cm. latus. *Lamina* circ. 1–1.20 longa, ecirrhifera vel interdum in

cirrhum abortivum, filiformem, inconspicuum, sæpe cum segmento terminali adnatum, ad 7 cm. longum exeuns, in rhachi eodemmodo leprosa, subtus secus rhacheos dorsum marginesque aculeis dispersis, reduncis, basi tumescentibus, apice atris, solitariis, interdum transverse connatis armata. *Segmenta* plura, untrinsecus circ. 50, alternantia vel subopposita, ad angulum 45° divergentia, lineario- ensiformia, maxima latitudine in media sita, circ. 20–23 cm. longa, 12–15 mm. lata, acuminata, basin versus attenuata et in marginibus crispata, infima subito oblique contracta, ad margines subtus secus costam mediam tantum et supra ad costas tres setulosa. *Inflorescentiæ fœminæ* foliis longiores, circ. 2 m. longæ, flagelliformes, in axi aculeis reduncis, solitariis vel digitatis, rigidis, ad 5 mm. longis armatæ, deciduo furfuraceæ, in ramos primarios 2–4 divisæ, pedunculo ancepiti, secus margines præsertim aculeis minutis prædito suffultæ. *Rami primarii* ad spatharum os orientes, statu juvenili in lobo spatharum libero obtecti, circ. 30 cm. longi, spiculas utinsecus 5–7 ferentes. *Spathæ: primariæ* basi tubulosæ, cylindricæ vel ancepites, aculeis dimensione variabilibus, ad 3 mm. longis rigidis, raro digitatis armatæ, apice in lobum, liberum, mox marcescentem, parce aculeolatum, in parte summa fere inermem, interdum fissum, in modo auris asini productæ; *secundariæ* perbreviores, circ. 2 cm. longæ, papyraceæ, infundibuliformes, in lobum acuminatum unilateraliter productæ, parce aculeolatæ. *Spiculæ* ad spantharum os secundarium orientes, axi flexuosæ, 8–12 cm. longae, florum glomerulos distichos, alternatos gerentes. *Spathellæ* infundibuliformes, oblique truncatæ, acuminatæ, aculeolis perbrevissimis, rigidis, basi tumescentibus scabridæ. *Involucrophorum* cupulare. *Involucra* profunde cupularia, in singulo involucrophoro germinata, connata. *Flores* ad singula spathella germinati, ambo fœminei vel in parte spicularum apicali alter neuter (masculus?). *Perianthium* fructiferum pedicelliforme vel subpedicelliforme. *Fructus* immaturi tantum visi, ovoidei, circ. 12 mm. alti, 6–7 mm. crassi, squamis per series verticales 18–22 dispositis, concoloribus, stramineis. *Albumen* homogeneum.

Patria: Nova Guinea borealis.

The plant described here is cultivated in the Botanic Gardens, Buitenzorg, under the gardens' no. X.E. 2, and is said to have been introduced from the northern parts of New Guinea. The herbarium collection studied by me bears the Singapore Field No. 30840. The holotype is preserved in the Singapore herbarium, and the isotypes will be distributed to the herbaria of Buitenzorg, Leiden, Kew and Berlin.

The edges of the leaflets are slightly turned upwards. Judging from the marks of the fallen flowers and fruits, it

appears that the two female flowers are borne at each spathel except in the distal ends of the spikelets where one neuter (or male?) and a female occur at each spathel.

It is extremely difficult to make this species fit in any of the sixteen groups into which Beccari has subdivided the genus *Calamus*. If the presence of the long dilated, auriculiform, free apical extension of the primary spathes is disregarded, the species would certainly fall into the *Group V*. Further the scabridity on the spathes and spathels would place *C. Steenisii* into the *Group V*-A, of which sub-division no species is known to occur in the part of the Indonesia lying to the east of Borneo. No member of this group is known to possess very long ocrea at the mouth of the leaf-sheaths, a character which, if one disregards the abovementioned scabridity, would put the species into the *Group V*-B, and precisely in the section which includes the species that occur in New Guinea alone.

But if the dilated ends of the primary spathes are taken into consideration, two *Groups VI and XVI* may partly lay claim to this species, though again no species belonging to both these groups are known to occur eastwards beyond Borneo. All the species of *Group VI* have spathes which split or open longitudinally almost down to the base into loriform laminæ. The species of *Group XVI*, though have the primary spathes similar those in *C. Steenisii*, differ from the latter in that they all have very much compressed, short spadices and ruminate seeds (*C. Steenisii* has very long spadices and non-ruminate seeds).

All this suggests the necessity of redefining *Groups V, VI and XVI*, or of creating a new one so as to keep several of the New Guinea species together and to include such species which, together with *C. anomalus* Burret, *C. Lauterbachii* Becc., *C. nannostachys* Burret, and *C. Steenisii*, cannot be made to fit definitely into any of the sixteen groups of Beccari, though all of them show marked affinities to the species in the three groups referred to above.

Calamus inopinatus Furtado **spec nov.** (*Planta mascula tantum visa*). *Caudex* soboliferus, acaulis, interdum ad 35 cm. longus, 2.5 cm. crassus, per totam altitudinem radices ærias ad 8 mm. crassas solum attingentes gerens. *Vagina* frondium 10–15 cm. longa, haud flagellifera et non gibbosa, in latere ventrali ad basin usque vel fere aperta, in petiolum sensim transiens, aculeis laminaribus, elasticis, ad 5 cm. longis, acuminatis, basi ad 4 mm. latis, digitatis vel interdum per series obscuras dispositis armata. *Ochrea* in modo alæ secus margines vaginæ enata, apice truncata, haud in lobos liberos producta, in alis utraque 6–10 mm. lata, rigida, fragilis, aculeis rigidis, acicularibus, atris, ad 5 mm. longis, basi, per series transversales interruptas connatis prædita, basin versus sensim in vagina evanescens. *Petiolus* 20–30

cm. longus, circ. 6 mm. crassus, teretiusculus, supra anguste canaliculatus, sulcos aculeorum exhibens, aculeis acuminatis, laminaribus, elasticis, stramineis ad 2.5 cm. longis, basi ad 4 mm. latis, apicem petioli versus solitariis, basin versus sæpe digitatis vel oblique subverticillatis. *Lamina* ad 1 mm. longa, imparipinnata vel fere; secus rhacheos dorsum in duabus partibus inferioribus tantum aculeis solitariis laminaribus, distantibus prædita, signis aculeorum conspicuis impressa. *Segmenta* numerosissima, æquidistantia vel fere, alternantia vel subopposita, 3–3.5 cm. inter se remota, ad 35 cm. longa, ad 2 cm. lata, lineario ensiformia, in apicem filiformem, setulosam terminata, intermediaria longissima, subtus roseo-tomentellosa, secus costas tres supra medium vel paulo infra setulosa, supra inermia, lævigata. *Inflorescentiæ masculæ* inermes, haud flagelliformes, frondibus breviores, ad 60 cm. longæ, in ramis primariis 3–4 divisæ, in rhachi spathisque deciduo fusco-furfuraceæ, pedunculo in vagina includente, nonnihil infra ochreæ apicem attigente. *Spathæ: primariæ* plus minusve striatæ, ad 6 cm. longæ, tubulosæ, apice oblique truncatæ, unilateraliter acuminatæ et in altero latere fissæ; *secundariæ* consimiles, æquilongæ vel minores; *tertiariæ* minores, infundibuliformes, acuminatæ, striatæ. *Spathellæ* consimiles, apiculatæ, in altero latere fissæ. *Rami primarii* 10–15 cm. longi, interdum ramus basalis ad 40 cm. longus, nonnihil infra os spatharum inserti, in ramos secundarios, interdum tertiarios, eodemmodo infra orificium spatharum orientes divisi. *Spiculæ* prope basin spatharum orientes; primariæ ad 9 cm. longæ, basin versus secundarias 2–3 cm. longas sæpe ferentes. *Flores* solitarii, alternati, confertissimi, ex spathellis usque duas partes exserti, in involucro profundo cupulari insidentes, utrinsecus in speculis primariis ad 15, ac in secundariis 9–12, ad 4 mm. longi, petalis sesqui longioribus quam sepalis, ambobus striatis, ovato lanceolatis.

PATRIA: ignota.

The plant is cultivated in the Botanic Gardens, Buitenzorg, and bears the gardens' no. X.E. 24. The specimens described here were collected by me under the Singapore Field number 30919. The holotype is preserved in the Singapore herbarium. Duplicates will be distributed to the herbaria of Buitenzorg, Leiden, Kew and Berlin.

This peculiar species belongs evidently to the *Group II* of Beccari and seems to be closely related to *C. Burckianus* Becc. from Java, which is probably also a stemless species; but it is described to have its petiole unarmed, leaf rachis unarmed or armed with small claws beneath, and the primary (three) costæ of the leaflets setose above and sometimes also beneath, whereas *C. inopinatus* has its petiole and rachis of the leaves armed with

rather long, laminar spines, its leaflets quite smooth above but armed along the three ribs beneath, as well as covered with minute, pinkish tomentum in the lower surface. The only other stemless *Calamus* is *C. pygæus* Becc., a species belonging to the *Group V* of Beccari and, therefore, differing in its spikelets and spadix-branches being sessile, that is, arising at the mouth of their respective spathes.

ON THE APPLICATION OF THE TERMS MALAYSIA AND MALAYA IN PLANT GEOGRAPHY.

By C. G. G. J. van Steenis,

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There is rather a lot of confusion about these terms, as pointed out by Haviland (1) so long ago as 1897.

The Malayan language is properly limited to Western Malaysia (Sumatra, Banka, Billiton, Riouw, Lingga, the Malay Peninsula and Anambas-Natoena Islands). It is in common use over the whole of the Netherlands Indies, originally on account of the seafaring habit of the Malays, who introduced their language along all coasts. Hence, the extremely wide distribution of the common Malay language. As soon as one meets inland people, one finds local dialects and languages.

Already H. Zollinger (2) had a good idea of the use of the word Malaysia (Malesia in Latin and German). He rightly proposed to indicate the whole of the tropical flora between Asia and Australia (including the Malay Peninsula) by the word Malaysia.

The Rev. J. E. Tenison-Woods published in 1889 an essay "On the Vegetation of Malaysia" (3). This is principally concerned with the Malay Peninsula, but it is clear from the text that he used the term Malaysia in a wider sense, though he did not define it exactly. He consistently used the term Malay Peninsula when referring to that area only, and other resident botanists have usually done the same. They tend to avoid the use of the word Malaya, but the term British Malaya is sometimes used. Recently H. J. Lam (4) used the latter term, but in the same article used also the term Malay Peninsula.

H. N. Ridley (5) used in general the term Malay Peninsula or Malaya for the Peninsula south of 7°, and Malay Islands for Netherlands India. Most other authors however follow Zollinger's proposal, made 80 years ago, and repeatedly advocated by E. D. Merrill (6), H. Bancroft (7), myself (8), H.J. Lam (4), and others.

F. N. Chasen (9) uses the term Malaysia to comprise only the Sunda shelf (Malay Peninsula, Borneo, Sumatra, Java, with the intervening small islands); Boden Kloss also used the term in that sense.

This is in slight contrast with the terms used by Zollinger (2), Merrill (6) and I. H. Burkill (10) who call the Sunda shelf region Western Malaysia, in contrast to the Sahul shelf which they indicate as Eastern Malaysia. It must be

said, that ZOLLINGER did not include the whole of New Guinea in his Malesia, but only its westernmost part. This is doubtless to be ascribed to the inadequate knowledge of the Papuan flora at the middle of the 19th century.

Several botanists, *e.g.* BECCARI in his "Malesia" exclude New Guinea from Malaysia, but include Assam, Burma and the Andaman Islands. The same view is held by ENGLER (11), WARBURG (12) and others who include in Malaysia the Indo-Chinese Peninsula, in contrast with ZOLLINGER (2), BURKILL (10) and RIDLEY, who take the NW. boundary of the true Malaysian stock at about 7° N. across the Siamese isthmus, where a rather abrupt change in flora is indicated.

Though nowhere in the world can absolute, pure and abrupt floral regions be distinguished, and gradual transition is the general rule, there is good reason to speak of an Indo-Malayan flora, comprising S.E. Asia and the Indo-Malayan Archipelago, which falls into two subregions; the Indian flora and the Malaysian flora, the latter having a common stock distributed from the Malay Peninsula as far as New Guinea. According to HOOKER, BENTHAM and others the Australian flora is also a modified part of the Indo-Malaysian stock but this dates back to the far past and Australia is to be distinguished nowadays as a separate centre.

Uniformity in the use of the terms, both geographically, historically and phytogeographically, is much to be desired. There are ample reasons for the following definitions:

MALAY PENINSULA, comprising the Malay States and Straits Settlements, is a *topographical* term. In phytogeographical sense its N. boundary is situated at ca. 7° N.

MALAYSIA includes the whole of the Netherlands Indies, Philippines, the Malay Peninsula, Sarawak, Br. N. Borneo, Brunei, Portuguese Timor, Christmas Island, and the whole of the island of New Guinea (Papua). It is a *biogeographical* term.

MALAYA is according to Mr. FURTADO and myself a word which is ambiguous and likely to cause confusion, especially to non-British botanists. There have been made several attempts to restrict it to mean "Malay Peninsula", but even today writers of local history and folklore have to define the word to show what they mean. Only a few years ago the term "Malaya" included Sumatra, Borneo, Rhio Archipelago, etc., so that the use of the term "British Malaya" was not uncommon and was used even on the survey maps of the Peninsula, and there are still books in the Malay Peninsula like "Official Guide to British Malaya". For phytogeographical purposes it would be better to use the word Malay Peninsula and to avoid on the whole the single term "Malaya" which can only give rise to confusion.

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THE GENUS LOMAGRAMMA

By R. E. Holttum

1. Historical.
2. Biology and Morphology.
3. Essential characters of the genus.
4. Distribution, and status of species.
5. Excluded species.
6. Keys.
7. Description of species (alphabetical order).
8. Species dubia.
9. Doubtful specimens.

1. HISTORICAL

Among the curious groups of climbing ferns of the Eastern tropics, Lomagramma seems to have attracted little attention, and there is no general account of the genus, chiefly perhaps owing to the inadequacy of collections. The various species, as indicated below, have been described by various authors at different times, and in many cases descriptions are very incomplete, so that a comparison based on published descriptions is quite impossible.

My interest in this genus was aroused when I undertook the study of Stenochlæna and the genera confused with it, all of them climbing ferns of similar habit to Lomagramma. I studied these ferns in the field in many places in the Malay Peninsula, and became also acquainted with all the stages of the life history of the two Peninsula species of Lomagramma. I then realised that these climbing ferns (except Stenochlæna proper) have two distinct leaf-forms, produced in response to the two different environments occupied by the plants: the moist shady lower levels of the forest, and the lighter and more airy upper regions reached by the climbing stems. This distinction has not been fully appreciated by most authors, and the low-level fronds have usually been ignored, or regarded as "abnomal". These fronds clearly play an important part in the life of the plants; they have distinctive characters and are important diagnostically. Having discovered these facts by observation of the local species, I feel that I am perhaps in a better position than others to deal with this genus, and have accordingly attempted to piece together an account of it, based upon the available specimens.

The genus Lomagramma was founded by John Smith in 1841 (*Journ. Bot.* 3 : 402). He cited the species *L. pteroides*,

which he based upon Cuming's no. 223, collected in the island of Luzon, and his description is as follows:—

> The single species upon which this genus is founded has the habit of Stenochlæna, but differs in the venation being reticulate. It is distinct in habit from the following, and in the sporangia forming a broad marginal line or sorus; and therefore in that respect partaking of the character of Lomaria, but differing in having reticulate veins, and being without a special indusium.

It is curious that the author should have happened to take as the type of his genus a species which is unique (so far as present knowledge goes) in having a marginal sorus instead of fully acrostichoid fertile pinnæ, and should have based the name of the new genus on that very character.

In his next paper (*l.c.* 4: 152), John Smith gave a further diagnosis of the genus, and added "presumably this fern may be the *Leptochilus lomarioides* of Blume, but his description is too brief to enable me to determine with certainty." The remark about Blume's description is correct. An examination of the types of both species, and of a number of other specimens, leads me to believe however that they are quite distinct; they differ constantly in various characters at all stages of their life history.

John Smith overlooked a yet earlier species, *Aspidium sorbifolium* Willd. This species, based on a young plant, was ignored by most later authors. Christensen in his *Index Filicum* doubtfully identified it with *Lomagramma polyphylla* Brack. Ching, examining the type in the Berlin herbarium, considered it to be identical with *Leptochilus lomarioides* Bl., but I give below reasons for believing him to be mistaken. In my opinion, *Aspidium sorbifolium* is one of the species *L. sumatrana*, *L. grosseserrata* and *L. Mathewii*, but I do not think it is at present possible to say which. Therefore I leave it as dubious species.

L. pteroides and *L. lomarioides* were lumped together by Hooker in *Species Filicum* under the name *Acrostichum Blumeanum* (*Chilolepton Blumeanum* Fée, based on specimens from Java). Hooker also included a specimen from Samoa, which I now describe as a new species *L. cordipinna*.

The next well founded species was *L. polyphylla* Brack. (1854), a very remarkable outlier in Fiji, having bipinnate fronds. Twenty years later Baker described another peculiar species from the same region, *L. cultrata* (Solomon Islands), having deeply lobed pinnæ, both sterile and fertile; this still remains known only from the original collection.

Beddome came next with *Lomagramma perakensis* (1892), a very distinct species from the mountains of the Malay Peninsula. Copeland distinguished the Bornean *L. Brooksii* in 1908; but he appears to have misunderstood the Philippine species in making two new varieties of L. pteroides the same year. Van Alderwerelt van Rosenburg, recognising for the first time that

there were two species of the genus in Java, described *L. abscondita* in 1922; unfortunately he omitted to examine the type of *L. lomarioides*, and the type of *L. abscondita* is identical with *L. lomariodes*, so that the second Java species still lacked a name. Van Alderwerelt described also *L. sumatrana* in the same year; this species occurs also in the Malay Peninsula.

In 1920 Brause described *L. novoguincensis*, a very distinct species from New Guinea. Two years later, Christensen described *L. sinuata*, from a specimen from Celebes; this species is in my opinion represented also in Borneo, East Java, and New Guinea, and our knowledge of it is increased by a recent collection from Java, including bathyphylls, kindly sent to me by Dr. Posthumus. *L. melanolepis* was described by van Alderwerelt from Ternate in 1922; it is probably closely allied to *L. sinuata*.

In 1930 Ching described *Campium Matthewii* from south China. The specimens were clearly bathyphylls of a Lomagramma. Ching subsequently recognised the genus, and regarded the species as identical with *Aspidium sorbifolium* Willd. This however appears doubtful, and I am still in doubt about assigning acrophylls to *L. Mathewii*.

Among the specimens I have examined, there are in my opinion four additional species which I here describe as new: *L. Copelandii*, a common Philippine species which has hitherto not been clearly distinguished from *L. pteroides; L. Merrillii*, an interesting small species from Mindanao; *L. cordipinna* from Samoa; and *L. grosseserrata* from Siam. The lowland species from Java remains unnamed, as it may prove to be identical with one of the species already described. It is likely that there are other distinct bipinnate species in Fiji and neighbouring island groups.

Among the specimens also are several which cannot definitely be assigned to any of the known species, but which are not adequate to serve as types for new species. It is possible that some of them represent bathyphylls of known species, but there are no definite connecting links. A list of these specimens is given at the end of this paper; they are from Celebes, Luzon, New Guinea, and Tahiti.

Ching has included in the the genus a species from South America, *Leptochilus guianensis* (Aubl.) C. Chr. I give elsewhere in this paper my reasons for excluding this species from Lomagramma, which thus appears as a genus extending from Assam and southern China through the Malayan region to the Pacific. Within this region occur also other species which have by some authors been regarded as belonging to Lomagramma but are here excluded, namely *Polybotrya Wilkesiana* Brack. and its allies; these I regard as allied to Teratophyllum.

2. BIOLOGY AND MORPHOLOGY

The species of Lomagramma are very interesting biologically. They are climbing plants, starting life (in all recorded cases) on rocks beside streams in shady forest, and later climbing high up large trees. As with some other climbing plants, the fronds they bear in their low creeping condition are different from those borne by the high-climbing stems. In an account of Teratophyllum, I proposed the name *bathyphylls* for the fronds produced in the low levels of the forest. A term is also needed for the high-level fronds; these will be called *acrophylls*, a term suggested to me by Dr. Christensen. There is sometimes more or less of a transition between the two, and there is a further difficulty that the bathyphylls are not all similar, those borne by the very young plants naturally being smaller than those produced later. There is however a real distinction between the two. A plant may go on creeping on the rocks for a considerable period with a quite slender rhizome and fronds which do not increase beyond a certain size. When it starts to climb a tree, the rhizome increases very quickly to a much greater thickness, and bears the much larger acrophylls. The production of fertile fronds appears in most species to be rather infrequent, or possibly seasonal; at least in the Malay Peninsula, where we have relatively slight seasonal change, fertile fronds have rarely been found. Probably, as in Stenochlæna and other ferns, the fertile fronds are produced during dry seasons. I once found fertile fronds of *L. sumatrana* on a plant which had been suddenly exposed by the fall of a neighbouring tree; this may have had a similar effect to that of a dry season. The spores are very thin-walled, without perispore. They appear unlikely to be able to withstand dessication, and the character may be connected with the streamside habitat of the plants.

The acrophylls of all species except *L. polyphylla*, and *L. cultrata* are simply pinnate with almost entire pinnæ. They are thus all very similar, differing in rather small characters, and some not very easily distinguishable. On the other hand, the bathyphylls are usually much more distinct, and from my field observations of the Peninsula species, and herbarium study of the large number of bathyphylls of the unnamed Java species which I have received from Buitenzorg and Pasoercean, I am convinced that the bathyphyll characters are good and constant. It is of course necessary to compare bathyphylls of similar size.

This state of affairs is almost exactly paralleled in Teratophyllum, and as in Teratophyllum, the earliest stages of growth, bearing immature fronds, are often quite distinctive. Full-size bathyphylls have usually all the pinnæ articulated; but in some species the earlier fronds, of smaller size, have the apex not articulated, but consisting of a narrow lobed lamina continuous with the rachis and different from the lateral pinnæ. I believe this character to be a good one; it certainly is so in the Peninsula

species, which are the only ones of which I have examined all stages in the field. The larger bathyphylls have pinnæ which are characteristic in number and spacing, size and shape, characters of base, margins, apex, texture and venation. The marginal teeth are more pronounced than in the acrophylls. I have not seen bathyphylls of all species; and in some cases, where bathyphylls have been collected separately, I am uncertain to which species they should be ascribed. I have not described them definitely unless I am sure of their species.

3. ESSENTIAL CHARACTERS OF THE GENUS

The essential characters which are common to all species of the genus are as follows :

Rhizome dorsiventral, when creeping slender, when climbing much stouter; the vascular system in section a single ring with several leaf-gaps, the ventral vascular strand (bearing the roots) double; fronds rather distant, especially on the creeping rhizome; surface with several longitudinal ridges, with grooves between them. The ridges are pale in colour in the living rhizome. They are decurrent continuations of the bands of aerating tissue on either side of the stipe; beneath them are gaps in the cortical sclerenchyma.

Scales abundant on younger parts of rhizome, and on young stipes, rachis and lamina, all similar in structure but differing in size according to their position; the base of the scales (especially the smaller ones) more or less bullate, the apex narrowed and sometimes acuminate, the cells usually translucent, with thin dark lateral walls; occasionally some of the larger rhizome scales not translucent (*L. sinuata* and *L. melanolepis*).

Stipes with an open ring of vascular strands, to at least 18 in number.

Rachis with anatomy as stipe; more or less winged towards the apex, the wing sometimes almost absent in the largest fronds, and often present throughout the rachis in the smallest.

Sterile pinnæ all articulated to the rachis (except the apex of small fronds of some species); the base rather unequal; the margins more or less toothed; venation without any main lateral veins, consisting of several series of areoles, the costal ones usually largest, without free veins (except sometimes at the margin).

Fertile pinnæ articulated, usually much narrower than the sterile; the lower surface, except for the midrib, entirely covered with sporangia (except in *L. pteroides* where the sporangia are confined to marginal bands towards the base of the pinnæ), the sporangia when young accompanied by peltate paraphyses of the same structure as the scales; the venation as in the sterile pinnæ but the areoles smaller, usually clearly visible on the upper surface.

Spores thin-walled, without perispore or tubercles, usually quite transparent.

The most distinctive of these characters are the scales, the venation, and the spores.

4. DISTRIBUTION AND STATUS OF SPECIES

So far as I can understand, no one species of Lomagramma is very widely distributed geographically as compared with the others. Our knowledge of the geographical distribution may be summarised as follows:

ASSAM, TONKIN & S. CHINA. L. Matthewii.
SIAM. L. grosseserrata.
MALAY PENINSULA & SUMATRA. L. perakensis, L. sumatrana (L. lomarioides in S. Sumatra).
JAVA. L. lomarioides, L. sp., L. sinuata.
TERNATE. L. melanolepis.
BORNEO. L. Brooksii, L. sinuata
CELEBES. L. sinuata.
NEW GUINEA. L. sinuata, L. novoguineensis.
PHILIPPINES. L. pteroides, L. Copelandii, L. Merrillii.
SOLOMON ISLANDS. L. cultrata.
NEW HEBRIDES. L. polyphylla?
FIJI. L. polyphylla, L. cordipinna.
TONGA. L. polyphylla?
SAMOA. L. cordipinna.
TAHITI. Species unidentified, new?

It is evident that much still remains to be discovered regarding these species, especially as regards their distribution. Collections are on the whole meagre, no doubt due to collectors being discouraged from collecting sterile materia[1]. Sterile fronds of Lomagramma (bathyphylls and acrophylls) would usually enable a species to be determined, and would be invaluable as indications of the distribution of the species, and of the constancy or otherwise of characters of the bathyphylls. They would also give definite correlation between the bathyphylls and acrophylls, which is lacking or doubtful in some species.

The species of Lomagramma are certainly closely allied together but I believe that they are distinct, and that sufficient material is available for an account such as the present paper to be of value. It is clear however that to characterise the species fully a description of all stages of their development is necessary. Some species are most easily distinguished in their young stages

or bathyphylls, some in their sterile acrophylls, and some in the fertile fronds. Therefore we shall not have a full understanding of the genus until we know all species in all stages, and we are still very far from this. For the same reason I find it very difficult to construct a key to the species.

Here is one of the many cases in which field observation is essential to supplement herbarium study, and if this paper should reach any persons who may be in a position to undertake such field study, or to instruct collectors, I would appeal to them to bear in mind the case of Lomagramma.

5. EXCLUDED SPECIES

L. guianensis (Aubl.) Ching, Amer. Fern Journ. 22: 17. 1932.

Leptochilus (Aublet) C. Chr. Index, cum syn.

I examined a specimen of this species at the British Museum. The spores have a large perispore, which I have never found in any species of Lomagramma. Further, the apical pinna is not articulated, but is continuous with the rachis. The venation is connected to typical Bolbitis venation by *Bolbitis serrata,* which has the pinnæ not articulated. In the British Museum Herbarium is also a specimen from Mexico (C. A. Purpus no. 7246); labelled *Leptochilus Turckheimii* C. Chr.; this has main lateral veins as in Bolbitis, but pinnæ articulate. It is evident therefore that the American Bolbitis species have produced a number of variants from the typical condition both in venation and articulation of pinnæ, and I suggest that *Lomagramma guianensis* (Aubl.) Ching is only a rather unusually aberrant species of Bolbitis which simulates the condition found normally in Lomagramma.

Lomagramma Wilkesiana (Brack.) Copel. Phil. Journ. Sci. 3C: 32. 1908.

L. articulata (J. Sm.) Copel. l.c. *L. bipinnata* Copel. Phil. Journ. Sci. 11C: 114. 1916. These three species, and perhaps also *Lomariopsis Balansæ* Fourn. (Ann. Sci. Nat. V, 18: 271. 1873), evidently all belong to the same genus, but I do not think that they are members of the genus Lomagramma. They have spores with perispore, and their venation is that of Teratophyllum, not Lomagramma. I have not yet been able to examine sufficient material of the species to understand them well enough to found a new genus for them, but I believe that this should be done when the material is forthcoming. The species are in my opinion closely allied to Teratophyllum and could possibly be included in that genus; to do this would necessitate an emendation in the definition of the genus which I gave in this Bulletin, Vol. 5, p. 277, a new section being constituted for the species under consideration.

6. KEYS

Owing to the fact that the species of Lomagramma in some cases differ most strikingly from each other in one only of the three leaf-forms, and also to the fact that in a few cases bathyphylls are still unknown, it is hardly possible to make a satisfactory key. It appears to me more useful to summarise briefly the distinctive characters of the various species under the headings bathyphylls, sterile acrophylls, and fertile fronds; whichever frond-type is then available, this summary should at least locate it within a small group of species, the detailed descriptions of which will provide further information.

BATHYPHYLLS

Pinnæ of largest fronds 25–30–jugate; apex of frond continuous with rachis, except in some of the largest fronds.
- pinnæ entire ... ... *L. lomarioides*
- pinnæ toothed
  - pinnæ to about 2.5 cm. long, drying reddish ... ... *L. pteroides*
  - pinnæ to 5 cm. or more long, not reddish when dry ... ... *L. grosseserrata*, *L. Matthewii*, *L. sumatrana*

Pinnæ of largest fronds 10–18–jugate; apex of frond always an articulated pinna, except in young plants of some species
- pinnæ entire ... ... *L. perakensis*
- pinnæ toothed
  - margins shallowly lobed, lobes about 5 mm. wide, each with 2–4 teeth ... ... *L. Copelandii*, *L. sp.* (Java)
  - margins not lobed
    - upper base suddenly subtruncate from a narrow beginning; lower base very narrow; apex blunt ... ... *L. sinuata*
    - base unequally cuneate; edges sharply serrate; apex acute ... *L. Merrillii*
    - upper base broad subtruncate; lower narrow; edges toothed towards apex; apex in small fronds somewhat rounded ... *L. Brooksii*

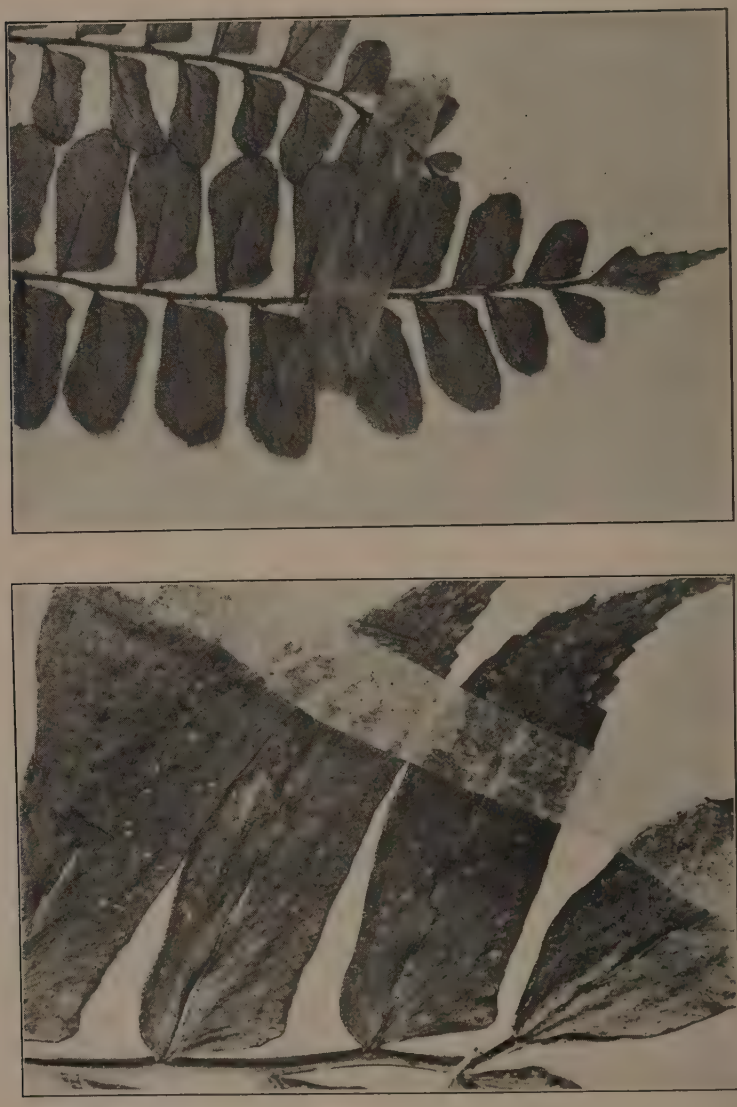
Bathyphylls unknown in *L. cordipinna, L. cultrata, L. melanolepis, L. novo-guineensis;* incompletely known in *L. polyphylla.*

STERILE ACROPHYLLS

- Bipinnate ... ... *L. polyphylla*
- Pinnæ lobed to costa ... ... *L. cultrata*
- Pinnæ at most shallowly lobed
  - Pinnæ, at least of old fronds, subcoriaceous, veins not distinct
    - Stipes 4 cm. long ... ... *L. Brooksii*
    - Stipes at least 15 cm. long
      - Pinnæ to 26 cm. long ... *L. perakensis*
      - Pinnæ not usually more than 12.5 cm. long
        - Pinnæ entire ... ... *L. lomarioides*
        - Pinnæ closely toothed towards apex ... ... *L. Merrillii*
  - Pinnæ thin in texture, the veins raised and distinct
    - Pinnæ with a winged stalk to 1 cm. long ... ... *L. sinuata*
    - Pinnæ hardly stalked
      - Base of pinnæ cordate, to 2.9 cm. wide ... ... *L. cordipinna*
      - Base of pinnæ at best subcordate, narrower
        - Edges deeply crenate-serrate *L. grosseserrata*
        - Edges not more than slightly toothed
          - Pinnæ to 11 by 1.3 cm. *L. novoguineensis*
          - Pinnæ larger, usually to 2 cm. wide
            - Pinnæ to 18 by 3 cm. edges not toothed *L. Copelandii*
            - Pinnæ smaller, edges slightly toothed ... *L. Matthewii*
              L. melanolepis
              L. sumatrana
              L. sp. (Java)

FERTILE FRONDS

- Fronds bipinnate ... ... *L. polyphylla*
- Pinnæ lobed to costa ... ... *L. cultrata*
- Pinnæ entire
  - Base of pinnæ always dilated, fertile at the edges only ... ... *L. pteroides*
  - Base of pinnæ not dilated, whole lower surface soriferous
    - Widest pinnæ 8 mm. or more wide
      - Pinnæ about 4.5 cm. long, apex rounded ... ... *L. novoguineensis*



Lomagramma borneensis. Above: apex of bathyphyll from young plant (Penrissen, Shelford). Below: apex of full-sized bathyphyll, showing articulated pinna (Holttum 25251). Both x 1.5.

Pinnæ usually not less than 10 cm. long, apex acute ... *L. cordipinna*
L. grosseserrata
L. Matthewii
L. sinuata

Widest pinnæ to 5 mm. wide
Pinnæ with stalks at least 3 mm. long
Pinnæ about 9 cm. long ... *L. Merrillii*
Pinnæ at least 15 cm. long *L. perakensis*
Pinnæ almost sessile
Pinnæ 1–2 mm. wide when dry ... ... *L. lomarioides*
Pinnæ mostly wider ... *L. Brooksii*
L. Copelandii
L. melanolepis
L. sumatrana

7. DESCRIPTION OF THE SPECIES

In the following pages I have usually given the original description of the species, with an amplified description of my own, based on all material which I have examined. Critical remarks and notes on the diagnostic characters are also included.

For permission to examine specimens, and for loan of material, I am indebted to the heads of the following Herbaria: Buitenzorg (B), Manila (M), U.S. National Herbarium, Washington (W), Kew (K), British Museum (B.M.), Calcutta (C), Pasœrœan (Pas.). The herbaria are referred to by the initials in brackets after the citation of specimens; Singapore herbarium is indicated by the letter S. I am also indebted to Prof. H. J. Lam for the loan of the type of *Leptochilus lomarioides* Bl. and to Dr. L. Diels for a photograph of the type of *Aspidium sorbifolium* Willd.

Lomagramma Brooksii Copel. Phil. Journ. Sci. **3c:** 345. 1908. Also l.c. **7c:** 60. 1912. **Plate 8.**

Rhizomate alte scandente, stipiteque 4 cm. longo paleaceis; rhachi deorsum paleacea, sursum fere glabra et anguste alata; pinnis sterilibus ca. 8 cm. longis, 15 mm. latis, fere integris, coriaceis, nisi ad costas glabris, basibus truncatis, apicibus falcatis breviter acuminatis, venulis immersis, areolis costalibus parvis, lamina viride, venulis infra rubellis; pinnis fertilibus plus falcatis, ca. 3 mm. latis, basibus dilatatis non auriculatis.

Sarawak, Bongo Mountain, leg. Hewitt and Brooks.

Near *L. pteroides* var. *subcoriacea* and *L. perakensis* Bedd. In the specimen sent me the pinnæ are sterile throughout the most of the frond, the apical ones being fertile. The occurrence of sterile and fertile pinnæ on the same frond is hitherto unknown in the genus. It is possibly abnormal in this case, but I believe the species is sufficiently distinct without this character.

In the latter publication above cited Copeland writes: Mr. BROOKS has sent me a very complete specimen, collected at Bau. It has the fertile and sterile fronds distinct, as in other species of the genus. The frond of a juvenile plant "which germinates on the limestone and may grow in large masses before reaching a trunk, and becoming scandent", has membranaceous, serrate, and very oblique pinnæ. Fronds of adult plants are as described, except in size. The sterile fronds are a meter or more long and 30 cm. wide. The fertile frond is still wider, its pinnæ 2 to 4 mm. wide, and straight or curved.

The species is nearest to *Lomagramma perakensis* Bedd, differing conspicuously in the very short stipes and persistent scaliness.

I have not seen the type of this species, but I have seen a considerable number of other specimens from Borneo which clearly belong to one species and agree pretty well with Copeland's description, except that I have seen none so large as indicated by Copeland's note of 1922 and I would not describe the pinnæ of bathyphylls as very oblique. The following description is based on specimens examined by me.

Immature Bathyphylls. Stipes to about 10 cm, fronds up to about 20 cm. long and 7 cm. wide with 12–15 pairs of pinnæ; apex continuous with the rachis; the lower pinnæ at right angles to the rachis, the upper oblique; pinnæ close, largest usually about 4.5 cm. long and 1.5 cm. wide; the upper base broad subtruncate, sometimes slightly auricled; lower base very narrowly cuneate or narrowly rounded in lowest pinnæ; midrib fulcate towards apex; edges toothed towards apex only, apex rounded in youngest plants, usually acute in older ones, width greatest about one third from apex. Texture thin; veins distinct and slightly raised on both surfaces, in 2–3 series of areoles, costal areoles not much larger than others.

Largest bathyphylls. Stipes to 10 cm. lamina to 40 cm. long and 12 cm. wide, pinnæ to at least 18 pairs, uppermost pinna articulate and like the others, largest pinnæ about 6 cm. long and 2 cm. broad, lower base rounded, much narrower than subtruncate upper base, margins toothed towards falcate acute apex.

Sterile acrophylls. Stipes usually about 4 cm. long. Fronds (Copeland's specimen to 1 m. long and 30 cm. wide; largest specimen below cited 75 by 20 cm. Largest pinnæ in middle third of frond, upper and lower gradually reduced. Middle pinnæ at right angles to rachis, to about 2 cm. wide, sessile, lower base a little narrower than the upper, and coming closer to the rachis, rounded to subcordate; upper base subtruncate; edges entire, sometimes wavy especially towards apex, but not toothed; apex acute, gradually narrowed from widest part of the pinna which is usually one third from apex. Texture thin but very firm; veins in three series of areoles, slightly raised and usually quite distinct on both surfaces. The lowest pinnæ usually slightly stalked, the base equal and subcordate.

Lomagramma Copelandii, Type, showing the sessile narrow fertile pinnæ, with base not dilated. 2/3 nat. size.

Fertile fronds. In the specimen seen by Copeland these are more than 30 cm. wide, the pinnæ 2–4 mm. wide. The only fertile fronds seen by me are those of Clemens from Penibukan, Kinabalu; these have stipes to 10 cm. long, and lamina to about 30 cm. long and 10 cm. wide. The pinnæ are up to 7 cm. long by 2 mm. wide, on winged stalks 2 mm. long; the veins usually distinct, the costal areoles elongate, the others almost round.

BORNEO. Kinabalu: Tenompok, 5,000 ft., Clemens 28638 (B); near Dallas, 3,500 ft., S.F.N. 25251, Holttum (S); Penibukan 4,000 ft., Clemens 30636 (M), 5,500 ft. Clemens 50263 (M). Exp. Nieuwenhuis, Jaheri 574 (B). N. Borneo Grens Comm. Amjah 517 (B), 525 (B), 417 (B), 585 (B). Penrissen, Sarawak, Shelford, s.n. 1899 (S, very young).

CELEBES. Menado, afd. Donggala, Kœlawi, 1000 m. Posthumus 2335 (Pas).

This species has been found in various parts of Borneo, and I believe also in N. Celebes; the Celebes specimen consists of rather large bathyphylls, which I cannot assign to any other species. The occurrence of the species in north Celebes, separated by a relatively narrow sea from B. N. Borneo, is not unlikely.

L. Brooksii (as here interpreted) is certainly similar to *L. perakensis* in its sterile acrophylls, differing in somewhat smaller pinnæ of rather thinner texture with more rounded base. The bathyphylls of the two species are very different, those of *L. perakensis* having quite entire pinnæ, the apical one articulate, from a very early stage.

Lomagramma Copelandii Holttum sp. nov. **Plates 9 & 10.**

L. pteroides auctt. p.p. non J. Sm.

L. pteroides var. *negrosensis* Copel. Leafl. Philip. Bot. II: 393. 1908.

A L. pteroidei differt: pinnæ bathyphyllorum maximorum c. 15-jugatæ, ad 6.5 cm. longæ, 1.8. cm. latæ, apicales articulatæ; pinnæ acrophyllorum sterilium ad 18 cm. longæ, 3 cm. latæ, basi superne late cuneatæ inferne rotundatæ, textura tenues; pinnæ fertiles ad 20 cm. longæ, 4 mm. latæ, sessiles, basi non dilatatæ.

Bathyphylls. Stipes from 2 cm. long in fronds of 12 cm, to 18 cm. long in fronds of 40 cm. In fronds to about 15 cm. long apex a narrow lamina continuous with the rachis; in full-sized bathyphylls, apical pinna like others and articulated, but smallest. Bathyphyll pinnæ to about 15-jugate, largest seen 6.5 cm. long, 1.8 cm. wide; base unequal, upper broadly cuneate, lower narrower, rounded except in lowest (somewhat reduced and reflexed) pinnæ in which lower base is narrowly cuneate; edges broadly crenate (lobes to 5 mm.), each lobe with 2–4 short teeth, largest pinnæ toothed only towards apex; apex not falcate, acute in pinnæ of larger fronds, blunt in pinnæ of smaller

fronds; texture thin; veins slightly raised on both surfaces, areoles in two series, costal ones usually largest.

Sterile Acrophylls. Stipe 15–25 cm. long. Pinnæ to 18 cm. long, 3 cm. wide, sessile; upper base usually broadly cuneate to subtruncate, more narrowly cuneate in the upper pinnæ; lower base usually rounded; edges slightly undulate, not toothed; apex acuminate, hardly falcate.

Fertile pinnæ to about 20 cm. long, 4 mm. wide when dry, sessile, the base not dilated, whole lower surface except midrib soriferous, areoles long and narrow.

TYPE. Luzon: Mt. Binuang, Prov. Tayabas, Bur. Sci. no. 28826, Ramos and Edano, in Philippine National Herbarium (duplicate in Herb. Buitenzorg).

This species differs very strikingly from *L. pteroides* in the various characters mentioned in the latin diagnosis. The bathyphylls with their large broad pinnæ are very distinct, being nearest to those of the unnamed species from Java; the pinnæ of sterile acrophylls are very broad and thin in texture, never subcordate as is often the case in *L. pteroides;* the fertile pinnæ are never dilated and partly sterile at the base, and are practically sessile.

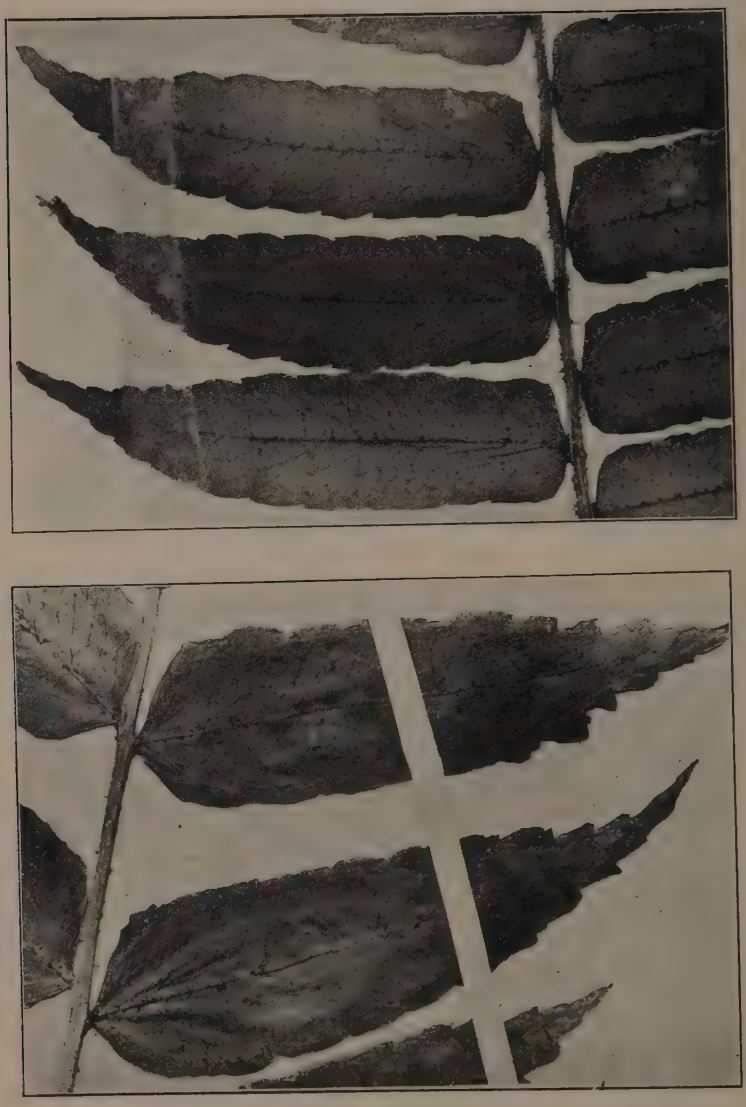
L. pteroides var. *negrosensis* seems to me to belong here, and probably consists of rather small plants of this species, perhaps from a shady place. The specimens show fronds on a rather slender rhizome, the pinnæ about intermediate in size between those of the largest bathyphylls and of the typical acrophylls, and somewhat toothed towards the apex.

L. Copelandii, like *L. pteroides,* is apparently distributed throughout the Philippine Islands. The specimens examined are as follows.

Luzon: Irosin (Mt. Bulusan), Prov. Sorzogon, Elmer 16919 (B, M.); Los Banos, Laguna, Copeland s.n. Mar. 16, 1906 (M, bathyphylls); Infanta, Tayabas Prov. Bur. Sci. no. 9331, C. B. Robinson (M, bathyphylls). *Catanduanes:* Bur. Sci. no. 30358, Ramos (B, M). *Samar:* Catubig River, Bur. Sci. no. 24810, Edano (M). *Bohol:* Bur. Sci. no. 42972, Ramos (M). *Mindanao:* Surigao Prov. Bur. Sci. no. 34816, Ramos and Pascasio (M); Mt. Apo, Cotabato Prov., Phil. Nat. Herb. no. 3244, Copeland (M); Camp Keithley, Lake Lanao, M. S. Clemens s.n. Sept. 1907. *Negros:* Dumaguete (Cuernos Mts), Prov. of Negros Oriental, Elmer 9678 (M, W, B; type of *L. pteroides* var *negrosensis*).

Lomagramma cordipinna Holttum sp. nov.

Bathyphylla ignota. Acrophylla sterilia ad 33 cm. lata; pinnæ mediæ 3.5–5 cm. inter se remotæ, breviter petiolulatæ, ad 17.5 cm. longæ et 2.9 cm. latæ, basi inæqualiter cordatæ vel subcordatæ, margine integræ vel leviter undulatæ, apice



Above: *Lomagramma grosseserrata,* pinnæ of bathyphyll.
Below: *L. Copelandii,* pinnæ of bathyphyll. Both x 1.5.

acuminatæ; textura tenues; venulæ prominentes, areolas 3–4 seriatas formantes; pinnæ apicales minores, basi rotundatæ apice leviter serratæ. *Pinnæ fertiles* petiolulatæ (petioluli ad 5 mm. longi), ad 12 cm. longæ et 1.1 cm. latæ, tota pagina soriferæ.

SAMOA. Pango-pango Bay, W. E. Safford, March 1888, U. S. National Herbarium (Type, 3 sheets). U. S. South Pacific Exploring Expedition 1838–42, s.n. (W).

FIJI. Korumbamba, July 1932, A. Meebold 16856 (B.M.)

This remarkable species is well represented by the fine collections of Safford. Though these include only the central and upper portions of the fronds of acrophylls, the pinnæ are so distinctive that there is no doubt of this being a good species. The cordate or subcordate base of the middle pinnæ, combined with the long-stalked and very broad fertile pinnæ (which are completely soriferous) are the peculiar features of the species.

Of the Fiji specimen, I have seen only a single pinna which I judge to be from the base of a frond; it is short and broad (8 cm. by 3.3 cm.) with almost equally subcordate base and rounded apex, the margins minutely irregularly crenulate towards the apex.

Lomagramma cultrata (Baker) Holttum comb. nov.

Acrostichum cultratum Bak. Syn. Fil. 524. 1874.

Baker's original description is as follows:

A. (*Chrysodium*) *cultratum* Baker; climbs on trees with fronds 6 ft. long; *barren pinnæ* ligulate, 6–8 in long, 1–1½ in broad, cut down to the rachis or a narrow wing into entire close blunt obovate lobes ⅜–½ in broad, cuneately narrowed to a broad base, or rarely produced and oblong, often several of the lower and sometimes the central lobes confluent; *texture* moderately firm; *surfaces* green, naked; *areolæ* small, exappendiculate; *fertile pinnæ* and lobes like those of the barren fronds, but the latter distant, 2–2½ lin. broad.

Hab. San Christobal, Solomon Isles, H. Richards, in Herb. Macleay.

The type sheet at Kew consists of pinnæ only. Most of the lobes are obovate, but some are almost evenly elliptical with a narrow base, almost like separate pinnules but not stalked nor articulate; these elliptical lobes vary in length. The fertile pinnæ are 10–12 mm. broad, the lobes almost circular and rather distant. The scales are typical of the genus, and the spores also.

This species is referred to *L. lomarioides* in Christensen's *Index Filicum*. It seems to me a very distinct and interesting species, a possible link between the pinnate and bipinnate species of the genus.

Lomagramma grosseserrata Holttum, sp. nov. **Plates 10 & 11.**

Species L. sumatrana affinis, differt pinnis acrophyllorum sterilum magnis, longe acuminatis, margine late crenato-serratis, pinnis fertilibus ad 1 cm. latis.

Bathyphylls. Stipes 8 cm. long (in the available specimen); lamina 40 cm. long, 10 cm. wide, lowest pinnæ slightly reduced, reflexed and more separated, upper six pairs gradually reduced; apex continuous with the rachis. Pinnæ 29 pairs, almost touching (except the lowest), largest 5 cm. long and 1.3 cm. wide, at right angles to the rachis, base only slightly unequal, upper base subtruncate, lower broadly rounded, apex slightly falcate acute, edges shallowly crenate-serrate, the teeth 4–5 mm. apart; texture thin translucent; venation in 2–3 series of areoles, the costal ones largest, the veins distinctly raised; scales with bullate base numerous.

Sterile acrophylls. Stipe to at least 20 cm. long. Pinnæ about 3 cm. apart, to about 19 cm. long and 2.5 cm. wide, sessile, the upper base broadly cuneate, the lower rather broadly rounded, margins rather deeply crenate-serrate, especially towards the apex, at intervals of 5–7 mm, the distal third gradually long-acuminate; colour dark dreen when dry; texture thin; veins slender, raised, brown on both surfaces, in about 3 series of areoles; scales numerous.

Fertile fronds. Stipe 18 cm. long. Lower pinnæ on stalks to 5 mm. long, pinnæ to 20 cm. long and 1 cm. wide, the upper pinnæ gradually more shortly stalked and smaller (in the specimen at hand the upper pinnæ are incompletely expanded); colour dark; veins distinct on the upper surface, in about 3 series of areoles, areoles more or less rounded except the costal ones; sporangia covering the whole lower surface except the midrib.

TYPE. Siam: Præ, Me Sai, 620–880 m. Winit no. 1019 (27-11-22), in Herb. Singapore.

This species is clearly allied to *L. sumatrana* and *L. Matthewii,* but it differs in the points mentioned in the diagnosis so strikingly that I cannot but consider it distinct. The bathyphylls are similar to those of the other species mentioned, but they differ from those of *L. sumatrana* in their greater length, and from those of *L. Matthewii* in the greater number of pinnæ, very regular and closely placed. As regards the apex of the bathyphylls, the specimens at hand has indications of articulation, but it is a very large bathyphyll, and I believe that smaller ones would have the apex clearly continuous with the rachis.

To this species should probably be referred the specimen cited by Beddome on p. 106 of the Supplement to his Handbook (Makum Forest, Lukhimpore, Assam). I have not seen this specimen.

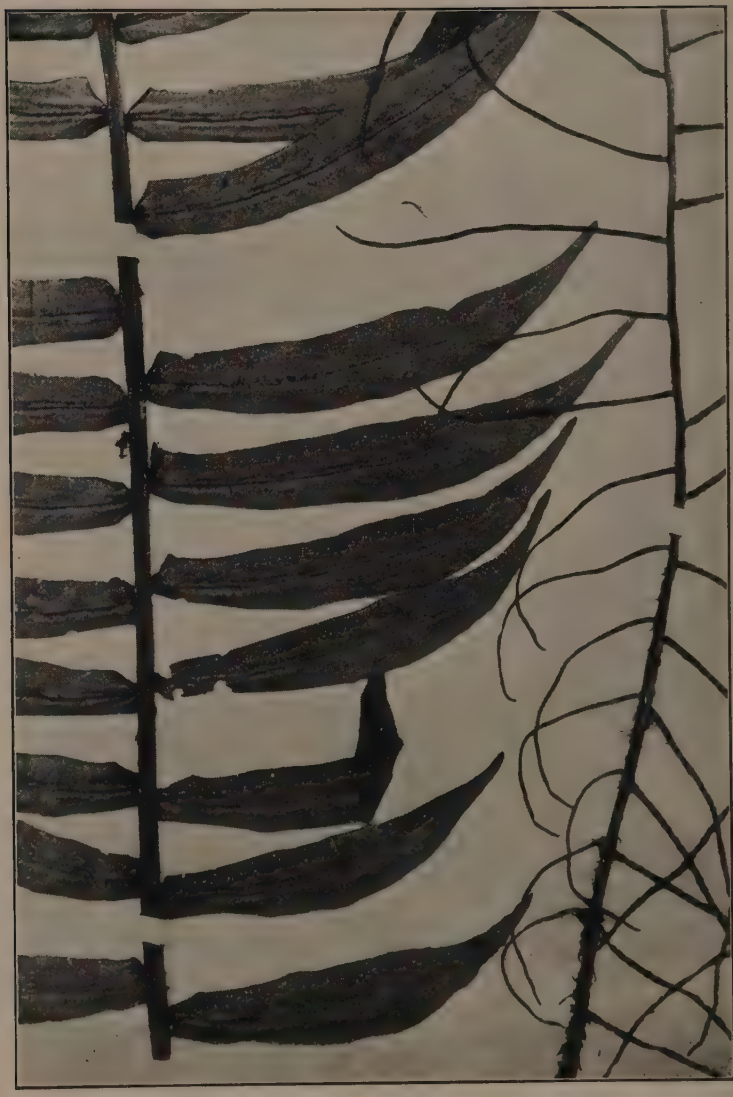
Lomagramma lomarioides (Bl.) J. Sm. Hist. Fil. 143. 1875. **Plates 12 & 13.**

Leptochilus lomarioides Bl. Enum. 206. 1828.

Chilolepton Blumeanum Fée, Hist. Acrost. 89, t. 51. 1845.

Acrostichum Blumeanum Hk. Spec. Fil. **5:** 268. 1864. p.p.

Lomagramma grosseserrata, Type; sterile acrophyll. 3/4 nat. size.



Lomagramma lomarioides, specimen from Blume's herbarium, showing sterile and fertile acrophylls. 2/3 nat. size.

Lomagramma abscondita v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XI : 16. 1913. *Ibid.* III ser. **2:** 159. 1920.

This species was described by Blume as follows :

"L. frondibus pinnatis, pinnis sterilibus lineari-lanceolatis, fertilibus angusto-linearibus elongatis stipite rachique paleaceis".

By the courtesy of the Director of the Rijksherbarium at Leiden, I have been able to examine Blume's specimens of this species. There are four sheets, one bearing the name in Blume's hand, the other three all clearly from one collection (perhaps the same collection as the type), and one of them labelled "Herb. Dr. Bl." Judging from the fact that Blume described the fertile pinnæ, which are not represented on the sheet actually bearing his writing, it seems probable that all four sheets were actually seen by him. In any case, they are quite certainly all of the same species, and they agree closely with the type *L. abscondita* v.A.v.R. and a number of other specimens from Java at Buitenzorg. I can therefore with confidence give a full description of the species, except that there are only three specimens which could be regarded as bathyphylls.

Bathyphylls. (description based on three collections from Tjibodas : Fleischer 276, Burck s.n., Palmer & Bryant 1190). Stipes to 15 cm. long, frond to 40 cm. long by 9 cm. wide; pinnæ to 25-jugate, the terminal ones articulate but smallest, with very narrow base. Middle pinnæ to about 5 cm. long and 1.0 cm. wide, the upper base broadly cuneate to subtruncate, the lower base narrowly rounded, edges quite entire, often slightly sinuate especially towards the apex, the apex falcate, acuminate. Texture firm, veins hardly visible on the upper surface, slightly prominent below, the areolæ rather small, usually in 2 rows. Palmer and Bryant's specimen from Salak represents a much younger stage, stipes 22 cm., frond 21 cm. pinnæ 16 pairs.

Sterile acrophylls. Young stipes and fronds very scaly, the scales thin and rather pale, mostly falling as the frond developes. Stipes to 20 cm. frond to 1 m. long and 20 cm. wide, the upper and lower pinnæ gradually reduced, the lowest only 5 cm. long, and more distant. Largest pinnæ to about 12.5 cm. long and 1.5 cm. wide, the upper base broadly cuneate to truncate, the lower base narrowly rounded, occasionally the upper base or both subauriculate. Pinnæ usually widest about the middle, apex gradually acuminate, falcate, the edges entire or undulate, often inrolled when dry. Texture of old fronds subcoriaceous, veins hardly visible on upper surface, usually somewhat raised below but rather broad. Blume's type has the veins more clearly visible than most of the other specimens; young fronds show the veins much more clearly than old ones.

Fertile fronds. Pinnæ sessile, to at least 18 cm. long, 1–2 mm. wide.

This species appears to be common on the mountains in the west of Java, and there are also specimens from east Java which I believe must also be referred to it, though they are not typical. The characteristic features are the narrow rather coriaceous pinnæ of the sterile acrophylls, the very narrow pinnæ of the fertile fronds, and the numerous narrow entire pinnæ of the bathyphylls. The sterile acrophylls are perhaps nearest to *L. Brooksii*, but *L. lomarioides* differs markedly from that species in the narrow fertile pinnæ and the narrow pinnæ of the bathyphylls.

TYPE: Java, Salak, Blume (Leiden).

Other specimens. Res. Preanger: G. Malang, Raciborski s.n. (B, M); G. Rasamala, Raciborski s.n. (B), Hallier s.n. (M); Tjibodas, Arsin 19624 (B), Burck s.n. (B), Bruggeman 438 (B), Palmer & Bryant 1190 (W), 212 (W), M. Fleischer 276 (M); Tjitibo, Tjidadap, Tjibeber, 1000 m., Bakuizen 2402 (B); Tjadas Malang, z.v. Tjibeber, 1000 m., Winckel 1699 (B); Mt. Salak 1000 m., Palmer & Bryant 550 (W), 557 (W); 700 m., 700 (W). *Res. Besoeki:* G. Idjen 1000 m., Posthumus 3774 (B); Weg *v.* Lidjen halfweg Kawah Idjen, 1025 m., Posthumus 378 (Pas); Mont. Tengger 1200 m., M. Buysman 108 (W).

Lomagramma Matthewii (Ching) Holttum comb. nov.

Campium Matthewii Ching, Bull. Fan. Mem. Inst. Biol. **1:** 158, fig. 3, 1930.

This species was based on a collection of large bathyphylls made by Dr. C. G. Matthew in Kwangtung. It was subsequently identified by Mr. Ching (Lingnan Sci Journ. **12:** 566. 1933) with *Aspidium sorbifolium* Willd. This identification however appears very doubtful, as explained under *Lomagramma sorbifolia* at the end of this paper.

I have seen Matthew's specimen in the Hong Kong herbarium, and judging from this and Mr. Ching's description I think it probable that certain specimens of bathyphylls from Assam are to be referred to this species. Also from Assam, and from Tonkin, are specimens of sterile acrophylls which are certainly not *L. grosseserrata* and perhaps belong to *L. Matthewii*. The only fertile frond which might be associated here is on the same sheet as one of the bathyphylls from Assam.

It is clear from the original collection of bathyphylls that *L. Matthewii* is closely related to *L. grosseserrata*, and in the absence of the quite distinct sterile acrophylls above mentioned, I should be inclined to include it with that species; these acrophylls show however that another species is present, but whether that species is *L. Matthewii* is another matter. The present collections are in fact inadequate for more than a tentative account of the species in the region between Assam and southern China to be given. I here quote the original description of *Campium Matthewii*, and add some notes about the other specimens which I think may belong to the species. It is just

Above: *Lomagramma pteroides,* a bathyphyll.
Below: *L. lomarioides,* a bathyphyll. Both x 1.5.

possible after all that the type of *Campium Matthewii* may represent bathyphylls of *L. grosseserrata.*

Campium Matthewii. Rhizome wide-creeping, naked, fleshy, light stramineous, terete, 5 mm. in diam.; stipes remote, pale green, 12–17 cm. long, terete below, deeply bisulcate throughout the rachis above, moderately paleaceous throughout the rachis, paleæ small, brown, membranaceous, lanceolate, acuminate; frond 35–50 cm. long, 10–13 cm. broad, linear oblong, slightly narrowed at base with the apex of rachis often lengthening out into a stout naked prolongation with proliferous tip, pinnate, pinnæ close, 20–27 on each side under the impari-terminal one, 7 cm. long, 1–1.5 cm. broad, gradually decrescent upwards, the uppermost ones 4 cm. or less long, sessile throughout, broadly linear-lanceolate, broadened downward, truncate or cuneato-truncate, acute, margin shallowly crenate above the base, texture thin papery, glabrous except the midrib which is sparsely scaly; venation distinct, main veins wanting, veinlets pauci-anastomosing in 2–3 rows of oblique irregular rhombic areolæ, of which the costal ones much the largest, extending to the half breadth of the pinnæ, all without included veinlets, the marginal areolæ mostly close, very rarely with excurrent free veinlets; fertile fronds not seen.

Distribution: Kwangtung: Lienchow, Dr. Matthew, No. 5108, Dec. 1907.

There is one curious point in the above description, namely "apex of rachis often lengthening out into a stout naked prolongation with proliferous tip". This I have not seen in any specimen of Lomagramma. The apex of the specimen of the type collection of *L. Matthewii* in the Hong Kong herebarium is missing, so that I am unable to verify the matter.

Bathyphylls of other collections. The following agree very well with Matthew's specimen, chiefly differing in the fact that the costal areoles are not so very much larger than the others.

ASSAM. Wallich, s.n. (C, from T. Moore's Fern Herbarium). Chima Forest, Garo Hills, 300 ft., Dec. 1890, Gustav Mann (W).

Sterile acrophylls. I have seen one good collection from Manipur (Meebold 6233, in Calcutta herbarium). This has pinnæ very like those of *L. sumatrana,* differing chiefly in the very broadly cuneate bases of the middle pinnæ. The pinnæ are up to about 12 cm. long and 2 cm. wide, margins entire except towards apex where they are rather sharply toothed.

There is another collection from Tonkin (Province de Hoa Binh, vers 500 m., Avril 1926, U.S. Nat. Herb.) with rather stout climbing rhizome, but the frond a rather intermediate one, having apex continuous with the rachis as in typical bathyphylls. It is in fact rather intermediate in character between the bathyphylls and acrophylls from Assam and Manipur above mentioned, and forms the strongest link connecting these specimens together.

Fertile fronds. Mann's specimen from Garo Hills, Assam, above cited, has part of a fertile frond, attached to a typical stout climbing rhizome, along with a large bathyphyll. The

fertile frond has a stipe 28 cm. long, and pinnæ to 16 cm. long and 8 mm. wide, on stalks 3 mm. long.

I am reasonably certain that the specimens above described from Assam, Manipur and Tonkin are one species, but I do not feel so sure that they are *L. Matthewii.* They are also rather near *L. sumatrana.* There the matter must be left until fresh collections are made.

Lomagramma melanolepis v.A.v.R. Bull. Jard. bot. Buitenz. ser. III, **5:** 212. 1922.

L. pteroideæ J. Sm. affinis.—Squamæ rhizomatis, stipitum, rhachidum costarumque sparsæ, nigræ vel obscure castaneæ. Frondes steriles c. 60 cm. longæ; rachis apicem versus anguste alata; ala ad basin pinnarum superiorum brevius vel longius dentiformi-auriculata. Pinnæ flaccidæ firmiter herbaceæ, subapproximatæ, sessiles, patentes, in sicco olivaceæ, supramedianæ maximæ, lineares, 12–13 cm. longæ, 1.75–2 cm. latæ, integerrimæ vel apice acuminato, recto vel subfalcato remote subserrulato-crenulatæ, basi obliquæ et plus minusve inæquilateræ, rotundatæ vel late rotundato-cuneatæ; venæ distinctæ, pallidæ (colore pinnarum). Frondes fertiles minores, usque as 40 cm. longæ, pinnis remotis, horizontalibus, contractis. Sori capsulis juvenilibus paraphysis longe stipitatis, peltatis copiose intermixtis.

Fertile frond of the specimen on hand still young, with the pinnæ 5 cm. long, 3 mm. broad.

TERNATE: Foramadjahi, in forest, 700 m. Beguin 1114 (B).

I have examined the type of this species. Like *L. sinuata,* it has narrow black scales on the rhizome and on the very young unexpanded fronds. Through an ordinary hand lens these scales appear black with irregular narrow paler margins. Through a microscope, the central cells are seen to have very thick black lateral walls, and the lumen is a brownish colour. The marginal cells have thin walls and some of them are elongated to give an irregularly fringed condition. The small scales on the frond are few; they are rather dark, but of typical bullate form and the cells normal.

The sterile pinnæ are hardly toothed, in which they agree with *L. sinuata;* but they are much smaller than the pinnæ of that species, and are sessile, lacking the peculiar basal characters. The fertile pinnæ are up to 4 mm. wide (not 3 mm. as stated in the description above quoted). They seem to be practically mature and are almost sessile.

The distinctive characters therefore are the rhizome scales, the medium sized almost entire sessile sterile pinnæ and the subsessile short and relatively broad fertile pinnæ.

At Ternate, this species falls within the range of distribution of *L. sinuata* and is presumably a local derivative. Further collections may possibly show it to have a range of variation bridging the gap with *L. sinuata.*

Lomagramma Merrillii Holttum sp. nov. **Plate 14.**

Bathyphyllorum lamina 16 cm. longa, 4 cm. lata, pinnæ c. 10-jugatæ; pinnæ laterales maximæ, 3.5 cm. longæ, 1.2 cm.

Lomagramma Merrillii, Type. The fertile frond is incompletely expanded. Twice nat. size.

Lomagramma novoguineensis (Docters van Leeuwen 9616), showing the upper surface of the broad blunt fertile pinnæ. Twice nat. size.

latæ, basi supra late infra anguste cuneatæ, margine acute serratæ, apice acutæ; pinna apicalis 6 cm. longa, 1.4 cm. lata, acuminata; textura tenuis, venulæ infra elevatæ, supra haud elevatæ.

Acrophyllorum sterilium stipites ad 15 cm. longi, lamina ad 45 cm. longa et 15 cm. lata; pinnæ superiores maximæ, inferiores sensim reductæ, infimæ c. 4 cm. longæ, stipitatæ 3 mm.; pinnae maximæ 9 cm. longæ, 1.7 cm. latæ, basi superne late inferne anguste cuneatæ, apice acutæ, falcatæ, margine apicem versus irregulariter dense sæpe obtuse serratæ, (margines pallidæ cartilagineæ), textura subcoriaceæ, venulis inconspicuis areolas parvas formantes præditæ. *Pinnæ fertiles* stipitatæ 5 mm., ad 9 cm. longæ, 3 mm. latæ.

TYPE: Mindanao, Dist. Zamboanga, Merrill 8282 (M), "very damp shaded ravine, on trees climbing, at 400 m.".

Other specimens. Mindanao, Camp Keithley, Lake Lanao, M. S. Clemens s.n. May 1907, Sept.–Oct. 1907 (3 sheets, M).

Merrill's specimen is the only one showing bathyphylls, for which reason I take it as the type. His sterile acrophyll is thinner in texture and more toothed than those of Mrs. Clemens; *i.e.* it is nearer to the bathyphyll condition. I believe however that all represent the same species. It is a rather small species, and is characterised by the combination of characters: small narrow bathyphylls with large articulated apical pinnæ, subcoriaceous pinnæ of sterile acrophylls, fertile pinnæ with stalks 5 mm., the pinnæ of moderate length. A character which seems to be almost general is that the stipes and rachis are usually reddish when dry; some are however stramineous.

The species has so far only been found in the island of Mindanao. It is very different from the two other species occurring in that island, *L. pteroides* and *L. Copelandii*.

Lomagramma novoguineensis (Brause) C. Chr. Index Suppl. III, 124, 1934. **Plate 15.**

Leptochilus novoguineensis Brause, Engl. Jahrb. **56:** 117. 1920.

Rhizoma scandens, validum, 5–7 mm. crassum, radices numerosas 1.5–3 cm. longas, fusco-pilosas gerens paleisque fuscis, sublinearibus, acuminatis margine subintegris, ca. 7 mm. longis 0.7 mm. latis, dense instructum, folia dimorpha interstitiis ca. 20 cm. longis emittens. Foliorum sterilium petioli 7–9 cm. longi, 4–5 mm. crassi, supra sulcati infra teretes, untrinque paleis iis rhizomatis subæqualibus densissimis muniti; lamina coriacea, ca 62 cm. longa, 22 cm. lata, supra glabra infra paleolis bulbosis prædita, ambitu oblonga, basi vix angustata, ad apicem versus e media laminæ parte decrescens pinnaque terminali sublineari, ca 3.5 cm. longa 2–3 mm. lata, basi leviter incisa desinens; pinnis articulatis, subsessilibus, e basi paulo angustata, subrotundo-truncata lineari-lanceolatis acuminatis, ad apicem versus levissime serratis, cetera in parte subintegris, 1–2.4 cm. inter se (costis) distantibus, alternis vel suboppositis, superioribus patentibus, intermediis inferioribusque horizontalibus, infimis 1–2-jugis interdum paulo

abbreviatis et deflexis, maximis (intermediis) 11 cm. longis, 1.3 cm. latis; rachibus petiolis similibus paleatis; costis utrinque paleis similibus sed minoribus supra sparsis infra densis armatis; nervis inconpiscuis areolas obliquas formantibus, nervis apice liberis nullis. Folia fertilia differunt petiolis paulo longioribus, ca. 12.5 cm. longis, pinnis e basi truncata, non angustata linearibus abrupte in apicem obtusiusculum desinentibus, margine subintegris, subpetiolulatis, maximis 4.5 cm. longis, 0.8 cm. latis. Sori totam inferiorem pinnarum partem occupantes.

TYPE: N. E. New Guinea, Kaiserin-Augusta (Sepik) River, Etappenberg, 850 m., Ledermann 9524.

I have not seen the type, but have examined another specimen from New Guinea: Mamberamo bij Albatros Bivak, 50 m., Docters van Leeuwen 9616 (Expeditie Nieuw Guinea 1926), in Herb. Buitenzorg. The striking feature of this specimen is the fertile pinnæ which are about 4.5 by 0.6 cm., with short stalks and blunt apices, as described by Brause. The sterile pinnæ are all somewhat damaged, and are rather smaller than described (to 9.5 cm. long), but I have little doubt that this is Brause's species.

Lomagramma perakensis Bedd. Handb. Suppl. 107. 1892. **Plate 16.**

Beddome's description is as follows:—

Rhizome 40–50 feet long, 1 in. diameter, epiphytic on trees; stipes 6–8 inches apart, about 1 foot long, slightly scaly, but scales soon deciduous, rachis not winged upwards; frond 3–4 feet long, very similar to those of Blumeana, but coriaceo-herbaceous in texture, pinnæ entire or obscurely crenated, quite glabrous or costa very slightly scaly, veins sunk and scarcely visible, venation very similar to Blumeana but closer and costal areoles smaller; fertile pinnæ 1–1½ lines broad.

Perak, 400 ft. alt. (Day). Referred by me to Blumeana in my list of Day's Perak ferns. Perak, 2,500–3,000 feet alt. (Dr. King's collectors, No. 8345), the pinnæ all fall off in drying, much more so than in Blumeana.

In Beddome's list of Day's collections (J. Bot. 1888, p. 2), the altitude is given as 4,000 ft.; the 400 ft. of the Handbook is doubtless an error. I have not been able to find Day's specimen, and it seems rather doubtful whether the specimen exists. It would therefore be best to take Kunstler's collection as the type of the species; specimens were distributed to several herbaria.

Th following description is based on the specimens in the Singapore herbarium.

Bathyphylls. Largest fronds commonly about 30 cm. long and 12–15 cm. wide, the stipe to about 25 cm.; pinnæ about 10–15 pairs, or even less, the apical pinna articulate and similar to the others; lower pinnæ largest in larger fronds, apical pinnæ largest in fronds of very young plants; rachis winged almost throughout. Pinnæ distinctly oblique or the lower ones sometimes horizontal, sessile; middle pinnæ with upper base cuneate

Above: apex of bathyphyll of *L. sumatrana* (the rachis continuous). Below: apex of bathyphyll of *L. perakensis*, from a young plant (apical pinna articulate). Both x 1.5.

about 45° to the midrib, lower base very narrow; edges entire, usually somewhat undulate, not toothed; apex subacuminate; midrib often somewhat falcate; texture thin but firm; veins slightly prominent above and below, often not distinct.

Plants with fronds only 4 cm. long have the apical pinna (15 by 4 mm.) articulate, the veins free or forming an incomplete series of areoles. Smaller fronds sometimes have an equally forked not articulate lamina at the apex.

Sterile acrophylls. Stipes to 40 cm. long; fronds to about 1.25 m. long. Rhizome to at least 1.5 cm. in diameter, densely scaly towards apex; stipes to 1 cm. thick at base, roughened from bases of scales. Pinnæ oblique, gradually smaller towards apex. Largest pinnæ 26 cm. long, 2.5 cm. wide, base rather narrowly unequally cuneate (upper base as much as 45° to midrib, lower always very narrow), edges slightly undulate, not toothed, more or less reflexed when dry, apex acuminate; midrib often slightly falcate towards apex. Texture of fully matured fronds subcoriaceous; colour olive green, often rather pale; veins usually more prominent on lower surface, but often almost immersed in the substance of the frond, rarely very sharply defined on the surface, usually in three series of areoles, the costal ones often smaller than the next series.

Fertile pinnæ to 40 cm. long (commonly 15–20 cm.) and 3–5 mm. wide when dry, on stalks 3 to 7 mm. long; midrib with two dorsal and three ventral vascular bundles (one in small pinnæ); venation in two or three rows of small areoles. The Pulau Tioman specimen has pinnæ only 12 cm. long; its sterile pinnæ are small also (13 cm. long, 2 cm. wide).

MALAY PENINSULA (all in H. S.). Sungei Ujong: Hullett s.n. Aug. 1880. Penang: Curtis 618. Pahang: Cameron Highlands 4,500 ft., Holttum s.n. 31.3.30; Robinson's Falls, 4,600 ft., S.F.N. 24994, 23259 (Holttum); Sungei Terla, 3,900 ft., S.F.N. 31329 (Holttum); Fraser's Hill, 3,600 ft., Holttum s.n. 18-9-23, 4,000 ft., Holttum s.n. 21-3-29; Bukit Kajang, Pulau Tioman, 2,000 ft., S.F.N. 18945 (Henderson). Perak: Taiping, 2,500–3,000 ft., King's collector 8345.

SUMATRA. G. Kœrintji, 1600 m., Bunnemeijer 8711 (B, two sheets, fertile only).

Bunnemeijer's specimens have long pinnæ, agreeing with *L. perakensis*, but in the absence of sterile fronds there is some doubt of the identity. They cannot be either *L. sumatrana* nor *L. abscondita;* if not *L. perakensis*, they represent a new species.

This very fine species appears to be quite distinctive in its bathyphylls; in its acrophylls it is nearest to *L. Brooksii* and *L. lomarioides*, which are mountain plants of Borneo and Java respectively.

Lomagramma polyphylla Brack. Cryptogamia, Filices, in Wilkes, U.S. Expl. Exped. **XVI:** 83, t. 12. 1854.

L. rhizomate scandente; stipitibus sulcatis furfuraceo-squamosis; frondibus bipinnatis; pinnis petiolatis alternis; rhachi marginata paleaceo-hirsuta; pinnulis glabris approximatis subalternis sessilibus oblongo-lanceolatis crenatis; costis sparsim paleaceis.

Hab. Ovolau, Feejee Islands: on trunks of trees.

Stipes thick and of a pale straw colour, about 8 inches long, with a few brown *furfuraceous scales,* which extend to the rhachis. Sterile *fronds bipinnate,* large, 2 to 3 feet long. *Pinnules* numerous, *approximate, glabrous, subalternate, sessile,* about 1 inch long and 3 to 4 lines broad, *oblong-lanceolate,* the margin irregularly *crenate.* Rhachis of the pinnæ with two broad marginal lines in front (a character not well represented in the figure), beset with slender fugacious paleæ. Fertile fronds wanting.

In the absence of the fertile fronds we infer from the habit of the sterile ones, with their articulated pinnæ and uniform reticulated venation, that our plant belongs to the present genus.

I have seen the type specimen in the U.S. National Herbarium. It has 9 pairs of pinnæ, oblique, all articulated; the middle pinnæ largest, about 20 cm. long and 5 cm. wide; pinnules all articulate about 20 pairs, slightly oblique, about 1 cm. apart, the largest about 2.7 cm. long and 0.7 cm. wide, the base not quite equally cuneate, the apex gradually tapering and slightly falcate, colour rather pale, veins distinct, pale, in two series of rather narrow oblique areoles, about 9 areoles in the costal series.

At the British Museum and Kew there are several other collections of bipinnate fronds from Fiji and the New Hebrides (Aneiteum); in the U.S. National Herbarium are also specimens from Eua Island, Tonga. Both the Aneiteum and Tonga specimens differ rather strikingly from the type of *L. polyphylla* and possibly represent distinct bipinnate species. The other specimens from Fiji however show in some cases intermediate characters. I think therefore that we must wait for further information before attempting to describe any new bipinnate species. Probably the matter will not be settled until someone makes careful field observations on these plants in the various island groups concerned.

The characteristic feature of the Aneiteum specimens is the very short pinnules (to about 1.4 cm. long), with few rather large marginal teeth and areoles to correspond. The specimen from Eua Island, Tonga, has pinnules slightly larger than those of the type of *L. polyphylla,* the margins broadly and slightly lobed, the costal series of areoles about 6 in number, to correspond with the lobes.

Bathyphylls are present in one of the Fiji specimens at the British Museum (Harvey), in one collection from Aneiteum and in the Tonga collection. In all cases they are simply pinnate, the pinnæ larger than the pinnules of the acrophylls, with shallowly lobed margins. One collection from Fiji (Meebold

Above: *Lomagramma pteroides,* a bathyphyll.
Below: *L. lomarioides,* a bathyphyll. Both x 1.5.

16885, B.M.) is a small bipinnate frond with rather large pinnules (to 4.8 cm. long and 1.5 cm. wide); this is perhaps a stage intermediate between typical bathyphylls and acrophylls, but it might possibly represent a distinct species.

Fertile fronds are present in one collection from Aneiteum (McGillivray, Kew) and in the Tonga collection. Both are very similar, the fronds bipinnate, of much the same size as the sterile ones, the pinnules reduced in size, to about 10 mm. long by 3 mm. wide. The spores are characteristic of the genus.

The following list includes all the bipinnate specimens I have seen.

FIJI. U.S. South Pacific Exploring Expedition 1838–42 (2 sheets, W, type collection). Seeman 713 (2 sheets, B.M.), 421 (B.M.). W. H. Harvey (2 sheets, B.M.). Nine miles above Suva, Meebold 16885 (B.M.). Korumbamba Hill, near Suva, Meebold 16831 (B.M.).

NEW HEBRIDES. Aneiteum, McGillivray 44, "woods, climbing trees" (Kew). Moore 1890, no. 17 (B.M.).

TONGA IS. Eua Island, H. E. Parks 16311 (W, 3 sheets). "Johannsen's plantation, climbing tall trees, alt. 150 m. Fruiting branches in top of tallest trees only. Vines many feet long".

Lomagramma pteroides J. Sm. Journ. Bot. **3:** 402. 1841. *ibid.* **4:** 152. 1841. Hook. Gen. Fil. t. 98. **Plate 13.**

Lomagramma subcoriacea Copel. Phil. Journ. Sci **40:** 308. 1929.

L. pteroides var. *subcoriacea* Copel. ibid. **3C:** 32. 1908.

The type of this species is Cuming 223, from Luzon. I have examined the specimens of this collection at Kew and the British Museum, and I can see no distinction from Copeland's species, of which I have seen the specimens of the type collection in the herbaria of Manila and Buitenzorg and also several specimens later distributed by Copeland. Copeland's specimens have rather narrower firmer pinnæ, drying reddish; but the essential characters of the broad base of the sterile pinnæ and the stalked fertile pinnæ with part of the lamina sterile towards the base are the same in both. The reddening of the fronds on drying is rather variable, and is perhaps to some extent connected with the method of drying and perhaps with the position of the plant and age of the fronds at the time of gathering.

The following description is based on all the specimens at my disposal. The description of the bathyphylls, which are quite distinctive, is taken from Merrill 780 (Paragua) and Copeland 1736 (Mindanao). These are perhaps not of a fully mature size.

Bathyphylls. Stipes short (longest seen 4 cm.). Largest frond seen about 28 cm. long by 4.5 cm. wide. Pinnæ to about

28-jugate, gradually reduced from the middle of the frond to the base, the lowest very small (7 mm. by 3 mm.) but not much more distant, the upper pinnæ gradually reduced towards the apex, which is continuous with the rachis and narrow, unlike the other pinnæ. Largest pinnæ about 2.5 cm. long and 0.7 cm. wide, the base unequal, the upper side broadly, the lower narrowly cuneate, the edges crenulate (teeth 2–3 mm. apart), the apex acute to somewhat blunt; bases and apices of lower pinnæ more rounded. Stipe, rachis and costæ rather densely scaly; scales rather dark. Pinnæ reddish when dry; veins strongly raised on both surfaces, in one or two series of areoles.

Sterile acrophylls. Rhizome with up to 5 leaf-gaps in transverse section, very stout in well-grown plants. Stipes usually 20–30 cm. long. Largest pinnæ seen 22 cm. long, 2.2 cm. wide; pinnæ commonly about 12–15 cm. long and 1.2 to 1.8 cm. wide, the base slightly unequally subtruncate to subcordate, the lower base narrower and more rounded to cordate, the sides subentire parallel, the apex acuminate, somewhat falcate, irregularly undulate or bluntly toothed; the uppermost pinnæ gradually smaller, often less truncate at the base, the apex more clearly toothed; lowest pinnæ (except on very small fronds) not much reduced, the base often equally cordate and distinctly stalked. Texture thin; colour often reddish; veins raised slightly on both surfaces, usually more or less brown on lower surface, the areoles rather small, in 2–3 series. Scales rather numerous, dark.

McGregor 235 from Negros shows an interesting transition from bathyphyll to acrophyll. The Washington specimen has the apex continuous with the rachis, the Manila specimen has the apical pinna articulate; in each case a fertile frond is attached to the same rhizome as the sterile.

Fertile fronds. Pinnæ to 27 cm. long, commonly about 20 cm., base unequally cuneate, widening rather suddenly from a winged stalk up to 1 cm. long; base of pinna 7–10 mm. wide, only the edge fertile, the upper part gradually narrowed, the distal half sometimes entirely covered with sporangia, but often with a narrow sterile lamina on either side of the midrib to the apex.

TYPE. LUZON, Cuming 223.

Other specimens. LUZON: Lucban, Tayabas, Elmer 9068, fert. (W, B). PARAGUA: E-wi-ig River, Merrill 780, bath. (W, M). NEGROS: Dumaguete (Cuernos Mts.), Prov. Negros Oriental, Elmer 10175, fert. (B, M, W). PANAY: Mt. Bulilao, Capiz Prov., Bur. Sci. no. 35754 (Martelino & Edano, S, M). MINDORO: Baco River, McGregor 235, fert. (W, M); Alag River, Merrill 5654, fert. (M); Mt. Halcon, Bur. Sci. no. 40657, fert. (Ramos & Edano, M). MINDANAO: Camiguin de Mindanao, Bur. Sci. no. 14764, fert. (Ramos, M); Cotabato, Distr.

of Zamboanga, Copeland 1736, fert. & bath. (W, M). SULU ARCH: Jolo, Clemens 9371, fert. (M).

This species has only so far been found in the Philippines, but within those islands it is widely distributed. It is very clearly characterised by the fertile pinnæ, which are the only ones having regularly a partial sterile lamina that I have seen in the genus. The bases of the sterile pinnæ are also distinctive but this character varies from base to apex of the frond and needs careful observation. There is much variation in the width of the pinnæ of the sterile acrophylls; and in the development of the reddish colour.

Lomagramma sinuata C. Chr. Svensk Bot. Tidskr. **16:** 98, f. 5. 1922.

Rhizomate ad caudices arborum late repente, lignoso, longissimo, 1.5–2 cm. crasso, inferne radicibus brevibus dense radicante, superne 5-sulcis, rimis acutis separatis, profunde sulcato, squamis minutis anguste lanceolatis adpressis atrofuscis sparse obtecto, denique dunudato. Foliis difformibus ex schedula pendentibus, valde remotis. Stipitibus foliorum sterilium cum rhizomate continuis ad 25 cm. longis, basi 6 mm. crassis, cinnamomeis, glaberrimis, superne auguste profundeque sulcatis. Lamina sterilis ovato-lanceolata, verisimiliter 1 m. vel ultra longa herbacea, siccitate brunnea, glaberrima; rachi non alata. Pinnis 10–15-jugis, usque ad 6 cm. inter se remotis alternis, erecto-patentibus (nec falcatis), petiolis 1 cm. longis stipitatis ad rachin articulatis, facile deciduis, e basi postice cuneata actice rotundato-truncata in petiolum decurrente oblongis, breviter acuminatis, 20 cm. longis 4 cm. latis, sinuato-repandis, margine ipso integerrimis, pinna terminale conformi. Venis distinctis reticulatis inferne elevatis, areolas 4–5 inter costam et marginem formantibus, areolis elongatis plerumque 5-angulatis, costalibus valde inæqualibus.—*Foliis fertilibus* minoribus, lamina ad 35 cm. longa, pinnis configuratione sterilibus similibus, 10 cm. longis, 8 mm. latis; stipite rachique paleis minutis lanceolatis adpressis centro atris marginibus basique lutescentibus onustis; sporangiis breviter pedicellatis paginam inferiorem excepto spatio mediano 1 mm. lato sparse paleaceo (paleis adpressis e basi peltata suborbicularibus in apicem longum acuminatum contractis) occupantibus; marginibus ipsis soris destitutis.

Bolaang-Mongondou, Modajag, North Celebes, 750 m., on stems of living trees, leaves pendent, fertile ones rare. W. Kaudern, no. 73 (B).

The characteristic features of full-sized acrophylls of this species are the long, very broad, thin, almost entire sterile pinnæ with their long narrowly winged stalks and the broad fertile pinnæ, also stalked; the venation of the sterile pinnæ is in several series of areoles, those towards the margins being very small. The scales on rhizomes and very young fronds resemble those of *L. melanolepis*.

I have seen a pinna of the type. I have also seen an entire fertile frond of another collection from Celebes, which agrees with Christensen's figure and description. These specimens have no bathyphylls.

There are specimens (including a fertile frond) from British North Borneo which appear to me to be referable to this species;

there are also specimens from East Java. From New Guinea (Papua) are specimens of sterile and fertile acrophylls collected by Carr; these agree exactly with Celebes specimens, except that the sterile pinnæ are rather long-acuminate. There is another specimen, from southern Dutch New Guinea (von Romer 216), which has smaller (but still acuminate) sterile pinnæ than the Papuan specimen, and the pinnæ are unstalked; the specimen consists of the apical part of frond, and it is possible that the basal part might have had larger and stalked pinnæ.

Of all these collections, only that of Dr. Posthumus shows bathyphylls, and it is fortunate that there can be no doubt of their authenticity. The collection consists of several fronds, both bathyphylls and sterile acrophylls. The latter are in my opinion typical of *L. sinuata* and Dr. Posthumus writes "the material belongs to one and the same plant". The bathyphylls are very similar to those of the unnamed Java species, and it might be difficult to distinguish them with certainty.

Bathyphylls. Stipes about 4 cm. long, fronds commonly to 22 cm. long and 7 cm. wide; pinnæ about 12-jugate; lowest pinnæ short and somewhat deflexed; apical pinna articulate, the base almost equal and the apex rather acute; middle pinnæ usually largest, commonly about 3.8×1.2 cm., the lower base very narrowly cuneate, the upper subtruncate but suddenly narrowing near the very base and so forming a sigmoid curve, the edges slightly and rather distantly toothed, especially towards apex, the apex rather bluntly rounded, texture thin, venation distinct, of two series of areoles; wing of the rachis rather unusually pronounced with an auricle below each pinna; scales fairly numerous on rachis, a medium brown colour.

The bathyphylls differ from those of the unnamed Java species in the sigmoid curve of the upper base, the less toothed margin, and the blunt apex; also perhaps in the rather large wing to the rachis and paler scales.

The specimens show another feature not mentioned in the original description, namely that the sterile acrophyll pinnæ are not always so long-stalked as described. The smaller acrophylls, and often the upper pinnæ of larger ones, would perhaps hardly be described as stalked, but they all have the sigmoid curve of the upper base described in the bathyphyll, only in a more pronounced degree. In the larger pinnæ this curve is exaggerated, and combined with a similar but much flatter curve in the narrow lower base gives a winged stalk. The lowest pinnæ of large acrophylls are rather short (not much more than half the length of the longest ones), and the lower base much broader, sometimes almost equal to the upper base, the winged stalk still present. In the pinna from the type collection in the Buitenzorg herbarium the winged stalk is only 5 mm. long, and this seems a common length.

Another correction of the original description (so far as complete specimens examined by me are concerned) is that the pinnæ may be up to 22-jugate.

CELEBES. N. Celebes: Kaudern 73 (type, as cited above). S. Celebes: Kosali-Porema, 650 m. Kjellberg 2608 (B).

BORNEO. B. N. Borneo: Menetendok, Kinabalu, 2,500 ft., Clemens s.n. 1-3-33 (S); above Koung, 2,500 ft., Clemens 51308 (M).

JAVA. Res. Pasoeroean, Tangkil Zuidergeberte, 400–500 m. Koorders 23554b (B). Res. Probolinggo, Mt. Lamongan, 450 m., Posthumus 3975 (S).

NEW GUINEA. Papua: Veiya, sea level, Carr 11677 (S). Dutch N. Guinea: von Romer 216 (B).

Lomagramma sumatrana v.A.v.R. Bull. Jard. bot. Buitenz. III. Ser. **2:** 158. 1920. **Plate 16.**

Leptochilus cuneatus R. Bonap. Notes Pterid. **XIV:** 453. 1923.

The original description of this species was as follows:—

L. lomarioideæ J. Sm. affinis sed pinnis sterilibus integerrimis vel ad apicem solum serratis, in sicco viridi-vel fusco-olivaceis, subtus quam supra pallidioribus, pinnis fertilibus anguste linearibus, 4–5 mm. latis subtus unique soriferis basi interdum sterilibus dilatatisque.

Forest; to 5 m. high scandent; alt. 350–500 m.—Originally determined by me as *L. pteroides* J. Sm.

SUMATRA (Deli, Sibolangit, J. A. Lörzing nos. 5564, 5623, 20th March–8 April 1918).

It is evident that by *L. lomarioides* in the above description the author meant the unnamed lowland species of Java, not the true *L. lomarioides* (=*L. abscondita* v.A.v.R.), which has quite entire pinnæ. I have examined the type of *L. sumatrana,* and believe it to be identical with the lowland species of the Malay Peninsula, which is well represented in the Singapore herbarium by bathyphylls as well as acrophylls. The following full description is based on Peninsula specimens so far as bathyphylls are concerned, and on both Sumatran and Peninsula specimens for the acrophylls.

Bathyphylls. Stipes 3–10 cm. long; lamina to about 40 cm. long and 9 cm. wide. Pinnæ 20 to 30 pairs, lowest rather reduced, more distant and reflexed, upper pinnæ gradually smaller, the uppermost grading into lobes on the apex of the frond which is not pinna-like and not articulated to the rachis. Largest pinnæ about 5 cm. long by 1.2 cm. wide, commonly about 4 cm. by 0.9 cm., at right angles to the rachis, upper base broadly subtruncate subauriculate, lower base half as wide, rounded or sometimes nearly cuneate, sides almost parallel for two-thirds of their length, than gradually tapering to acute or subacute apex; edges shallowly crenate with one or two sharper teeth at the distal end of each lobe, the teeth or groups of teeth 3–5 mm.

apart. Texture thin, colour usually green when dry but sometimes brown; midrib pale, raised above and below, veins distinctly prominent on both surfaces when dry, concolorous with the surfaces, slender.

Sterile acrophylls. Stipes to 20 cm. long; frond to at least 90 cm. long and 25 cm. wide. Lowest pinnæ somewhat reduced and more distant, uppermost gradually smaller, apical pinna articulate and same shape as others. Middle pinnæ to about 14 cm. long and 2 cm. wide (occasionally to 2.5 cm.), at right angles to the rachis or slightly oblique, sessile or stalked less than 1 mm., base broadly cuneate above, rounded to cuneate below and about half as wide, edges usually distantly toothed towards apex, otherwise entire, sides approximately parallel for ⅔ of their length, apex acuminate; texture thin but firm, veins raised above and below, in 3 series of areoles, the costal areoles not considerably larger than the next series.

Fertile fronds. Pinnæ 2.5 to 3 cm. apart, to about 15 cm. long by 5 mm. wide, stalked to 2 mm., the base unequal; upper pinnæ gradually reduced to about 4 cm. long; venation in 2 or three series of areoles, usually prominent above; lower surface soriferous throughout except for the midrib and the thin pale edges.

The characteristic features of this species are the long narrow bathyphylls with many pinnæ and the apex not articulate, the broad sterile acrophyll pinnæ, thin in texture and slightly toothed at most towards the apex, and the broad slightly stalked fertile pinnæ.

I have not seen Brooks's specimen from southern Sumatra which was described by Bonaparte as *Leptochilus cuneatus*, but from the description (especially of the broad fertile pinnæ) it appears almost certainly to belong here. Bonaparte quotes also under *Leptochilus cuneatus* a specimen of Raciborski from Java (Salak). It seems possible that this is a paratype of *L. abscondita* (*L. lomraioides*) but if so the description would not apply to it. I have seen no specimens from Java to which the description of *L. cuneatus* would apply.

In his description, v.A.v.R. has the phrase "basi interdum sterilibus dilatatisque", referring to fertile pinnæ. The type collection has a frond which is partly fertile and partly sterile, and at the transition region some pinna are sterile at the base with fertile apical half. This is of course not a character of the species, but just a chance occurrence.

L. sumatrana occurs in the low country and foothills of the Main Range in the Peninsula, and, so far as recorded, in low country also in Sumatra. The mountain species is *L. perakensis*, which is very different at all stages.

SUMATRA. Sibolangit, 475 m., Lörzing 5564 (B, S, M), 5623 (B). Benkœlen, Lebong Tandai, Brooks 4678 (type of *Leptochilus cuneatus* R. Bonap., not seen).

MALAY PENINSULA (all S). Selangor: Ginting Simpah, 1,500 ft., S.F.N. 26104 (Holttum). Negri Sembilan: Ulu Bendul, S.F.N. 9859 (Holttum). Pahang: Pulau Tioman, W. of Joara Bay, S.F.N. 1138 (Burkill). Perak: Chanderiang, 500–1,000 ft., King's Collector 5778 (distributed as *Acrostichum perakense* Bedd.).

Lomagramma sp.

As noted by van Alderwerelt van Rosenburgh, there are two species of Lomagramma in Java (in addition to *L. sinuata*, which has been twice collected in East Java); van Alderwerelt accordingly decided to provide a name for the second species. Owing to the fact that he evidently never saw the type of *L. lomarioides*, he gave a new name to that species instead of the other, which therefore still lacks a name. The unnamed species is evidently a fairly common one in some parts of Java, but curiously enough it has never been collected in a fertile condition. It is very similar to *L. Copelandii*, and might possibly be identical with that species. In view of this uncertainty, I do not name it here, but give a description of the bathyphylls and sterile acrophylls. The bathyphylls are rather similar to those of *L. sinuata*, but the pinnæ are much more toothed, more inclined to have an acute apex, and the scales are more numerous and darker. The acrophylls lack the characteristic base of *L. sinuata* and are distinctly toothed towards the apex.

Bathyphylls. Smallest fronds seen, with lamina 12 cm. long, have the apical pinna largest and articulated like the others. This condition persists in bathyphylls up to 25 cm. long; in larger fronds the largest pinnæ are about one-third from the apex, the apical pinnæ somewhat reduced. Middle pinnæ of typical fronds about 4 cm. long and 1.1 cm. wide, the upper base truncate to broadly cuneate, the lower base very narrowly cuneate, the apex gradually tapered to an acute point (or rounded in the smaller pinnæ), the midrib slightly falcate, the margins slightly lobed, the lobes about 4 mm. wide, each with 2 or 3 teeth, the basal ones sometimes not toothed; lowest pinnæ with lower base more broadly rounded, and apex rounded. Pinnæ to about 18-jugate, usually separated by about half their own width; texture thin; veins raised on both surfaces, areoles in two series.

Sterile acrophylls. Stipes to 15 cm. or more; frond to 60 cm. long and 20 cm. wide; pinnæ to at least 20-jugate. Largest pinnæ about 12 cm. long and 1.8 cm. wide, midrib slightly falcate, upper base broadly, lower more narrowly cuneate, sides parallel for more than half their length, entire except for the apical third which is distantly toothed (teeth 4–5 mm. apart), apex acuminate. Texture thin; veins raised on both surfaces, usually pale on the lower surface, areoles in about 3 series, costal ones somewhat larger than the next. Lowest pinnæ somewhat reduced, the base more broadly cuneate.

Fertile fronds not seen.

This species is certainly very like *L. Copelandii*. The youngest plants differ from that species in having the apical pinnæ articulate from a very early stage and larger than the others; larger bathyphylls differ in having the lower base of the pinnæ broader, and in a larger number of basal pinnæ reduced and reflexed; acrophyll pinnæ differ in being distinctly toothed towards the apex.

JAVA: *Res. Pasœrœan:* vœt G. Smerœ, 400 m. Posthumus 1613 (P); helling G. Smerœ, 700 m. Posthumus 1621 (P); bij Waterval Sœmberwangi, 300 m. Posthumus 1508 (P, S); helling G. Smerœ 825 m. Posthumus 549 (P, B); helling G. Smerœ 400 m. Posthumus 1608 (P). *Res. Batavia:* Buitenzorg 240 m. Bakhuizen fil. 3123 (B); Sitœhiang 500 m. Bakhuizen 6452 (B,S); Kloof v/d Salak, Bakhuizen 6304 (B); Gœnong Batœ, 250 m. Bakhuizen fil. 3664 (B); Botanic Gardens, Buitenzorg (B), Posthumus s.n. 1925 (P).

SUMATRA. Aer Telani Kloof, 11 km. N. van Banging Agœng, Ranau N. W., 400 m. van Steenis 3951 (B).

8. SPECIES DUBIA

Lomagramma sorbifolia (Willd.) Ching, Lingnan Sci. Journ. 12: 566. 1933.

Aspidium sorbifolium Willd. Sp. Pl. 5: 23. 1810.

This species was described by Willdenow as follows:—

A. frondibus pinnatis, pinnis lanceolatis alternis obtusiusculis, serratis, basi superiore truncato-subauriculatis, inferiore cuneatis, rachi paleacea. W.

Habitat in India orientali.

Caudex filiformis repens glaber, *Stipes* pollicaris glaber. *Rachis* paleis brevibus obsita. *Frondes* quinquepollicares pinnatæ. *Pinnæ* mediæ pollicares, inferiores et superiores sensim breviores, lanceolatæ obtusiusculæ remote serratæ serraturis 5 vel 6 in utroque latere, basi superiore truncatæ, vix manifeste auriculatæ, inferiore cuneatæ. *Costa media* paleis parvis ventricosis obsita. *Soros* perfectos non vidi. W.

Prof. Diels has very kindly sent me a photograph of the type of the species, which is in the Berlin herbarium. As one would anticipate from the description, the specimen consists of bathyphylls from a young plant. The pinnæ are similar in many respects to the lowland species from Java and also to *L. sumatrana*, *L. grosseserrata*, and *L. Matthewii*. These species however differ very markedly in the apex of the bathyphyll. In the Java fern the apical pinnæ are similar to the others, subequal, and articulated. In the other species the pinnæ are gradually reduced to the apex of the frond, which consists of a narrow lamina continuous with the rachis. Willdenow's specimen has the latter character, and is quite unlike any specimen I have seen from

Java. It is probably one of the other three species, but our present knowledge is not adequate to say which. The only course therefore is to ignore Willdenow's name for the present.

9. DOUBTFUL SPECIMENS

There are several doubtful specimens, some of which may represent new species, but the material is inadequate for a full description to be possible. Some of the specimens may represent bathyphylls of known species; but there is no definite evidence of this. It is clear from the foregoing descriptions that for a full characterisation of a species of Lomagramma all stages of development must be available; species resembling each other at one stage may differ strikingly at another.

LUZON. Rizal Province, Loher 23150 (M). This specimen consists of bathyphylls about the same size as those of *L. Copelandii*, but differing in the shape of the pinnæ, which are more oblique and falcate, the upper base subauriculate, the lower base more narrowly cuneate, the edges not lobed and only irregularly toothed towards the apex. Judging by the bathyphylls of those species in which a number of specimens are available, I do not think it likely that this specimen comes within the range of variation of *L. Copelandii*. It is probable therefore that there is another Philippine species and to it may possibly belong some of those specimens which I have referred to *L. pteroides* or *L. Copelandii*, but until full collections of all stages are available nothing further can be said.

NEW GUINEA. N. New Guinea, H. J. Lam no. 1200, 13-9-1920 (B). This specimen consists of very small bathyphylls, all of about the same size, to about 7 cm. long (including the stipe) and 2.8 cm. wide. The collector noted that the fern was very abundant on the ground and on roots (of trees presumably) but that no fertile fronds could be found. This specimen might perhaps be a very young stage of *L. novoguineensis*, or even of *L. sinuata*, but there is no character in the bathyphylls of Lam's specimen to give a definite connecting link with either species.

CELEBES. Manado Resid., Tomeolama, 700 m. C. A. Wisse no. 71 (B). This specimen consists of four bathyphylls rather similar to those of the specimen from Luzon above quoted, but the pinnæ more regularly toothed. It might well be the same species.

TAHITI. M. Vesco 1847 (M, ex herb. Mus. Paris.). This specimen is the apical half of a sterile acrophyll, which is very near the unnamed Java species in appearance.

26093—350—4/37